The Engineer

LONDON, FRIDAY, JUNE 27, 1941.

PUBLIC NOTICES

UNIVERSITY COLLEGE OF SWANSEA

(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF WALES.)

Principal: C. A. EDWARDS, D.Sc., F.R.S.

APPLIED SCIENCE DEPARTMENTS

ENGINEERING

Professor: Frederic Bacon, M.A. (Cantab.), A.M. Inst. C.E., M.I. Mech. E., M.I.E.E.
Lecturer in Electrical Engineering: R. G. Isaacs, M.Sc. (Bristol), B.Sc. (Lond.), A.M.I.E.E.
Lecturer in Civil Engineering: A. A. Fordham, Ph.D. (Lond.), A.M. Inst. C.E., M.I. Struct. E.
Lecturer: J. Selwyn Caswell, M.Sc. (Wales), A.M.I. Mech. E., A.M. Inst. C.E.
Assistant Lecturer: W. E. J. Farvis, B.Sc. (Bristol).

METALLURGY

Professor: C. A. Edwards, D.Sc. (Manchester), F.R.S.
Assistant Professor: R. Higgins, Ph.D. (Glasgow).
Lecturer: R. Griffiths, M.Sc. (Wales).
Assistant Lecturer: T. B. Wilkinson, Ph.D., B.Eng. (Liverpool).

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Entrance Scholarships will be offered for competition in April, 1942.

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1940 No. 877
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The Engineer

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IMPORTANT NOTICE

All correspondence dealing with Editorial, Advertising and Subscription Matters should be addressed to: 28, ESSEX STREET, STRAND, LONDON, W.C. 2

Remittances and Letters dealing with Accounts should be sent to:

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"THE METALLURGIST."

This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER each alternate month. Next date, August 29th.

ADVERTISEMENTS.

The charges for Classified Advertisements are 1/- per line up to one inch—minimum charge 4/-; those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Wednesday afternoon.

Letters relating to the Advertisement and the Publishing Departments of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

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For continuation of Small Advertisements see page 70

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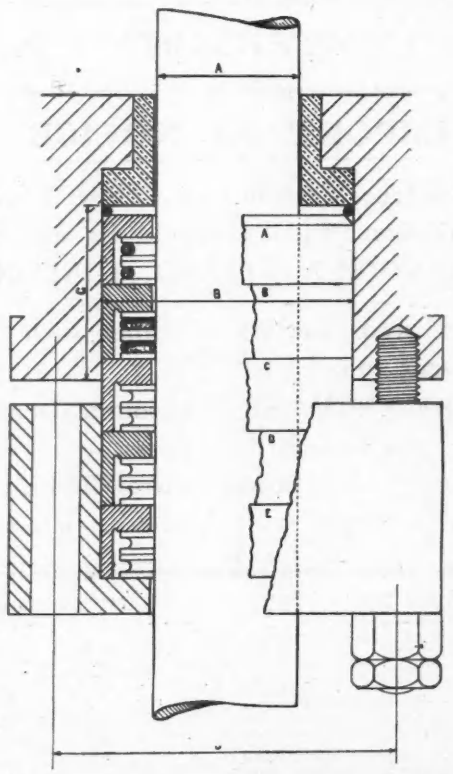

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Red Cross gratefully acknowledges free gift of this space.

A Seven-Day Journal

Increased Coal Production

ON Monday, June 23rd, a joint appeal to ex-miners to return to the mines was made by the Minister of Labour and National Service, Mr. Ernest Bevin, and the Secretary for Mines, Mr. D. R. Grenfell. War industries need coal in increasing quantities, it was pointed out, and people's homes must be kept warm next winter. An additional half million tons must be raised each week during the next few months so as to be transported and stored while the days are long and transport conditions are at their best. The Government therefore appeals to former mine workers to volunteer at once to return to the pits and help in this urgent war work. Volunteers will be protected against unemployment and short time. The Essential Work (Coal Mining Industry) Order secures them a wage at the full trade union rate for their occupation and grade even if work is temporarily not available. If for any length of time they are not needed in the pits to which they have returned they will be found work at other pits or they will be found temporary work in another job of national importance. They will receive wages in the intervals between jobs. It is the patriotic duty of every ex-miner to find out whether he ought to return to the mines, and go to the nearest Employment Exchange and ask for advice. The Exchange will take all particulars and note to what pit a man wants to return if he has a special preference. In every coalfield there is a system of District and Pit Coal Production Committees, on which representatives of the employers and the men's unions sit together. If a man ought to go back to mining, the Exchange will send particulars to the Production Committee covering the district he wants to go to. This Committee is responsible for allocating men to collieries and for arranging lodging if a man is not going to live at home. The local Welfare Officer of the Ministry of Labour and the Pit Production Committee will help them in this. While arrangements are being made volunteers should stay at their present work. The Employment Exchange will let them know as soon as arrangements have been made for them to travel. They will then be given free travelling vouchers and money for incidental expenses. Immediately they report at the pit in accordance with instructions they will rank for wages. While there are some ex-miners at present employed in certain vital war production who cannot be released, the authorities in charge of the various production departments have promised to give every assistance in securing in every possible case the release of ex-miners who volunteer to return to the mines as a result of this appeal. In some cases it may be possible for men who go back to the mines to return to their present employment when the summer is over.

Registration of All Building Firms

IT was announced by the Ministry of Works and Buildings on Monday, June 23rd, that a registration of all builders throughout Great Britain is to be made in the near future. This is a further step in the drive for increased output, which was referred to by Lord Reith, Minister of Works, when explaining the reasons for the application of the Essential Work Order to the building industry, as reported in our last issue. Details of the registration will be issued shortly. Every builder will be obliged to state the number of men, skilled and unskilled, he is employing and the work he is engaged on. Details will also be issued in due course of the establishment of the National Building Council. The Council will consist of representatives of all sides of the industry under an independent chairman. The chairman has not yet been selected, but the greatest possible care is being taken to find a man whose eminence and authority are such as to inspire the confidence necessary for this difficult office. The function of the Council will be to facilitate the smooth working of the industry and to ensure a state of mutual trust, so that all concerned will be able to direct their full effort to every vital work before the industry. Further steps towards the elimination of non-essential building work will also be taken shortly.

Technical Education

ON Friday of last week, June 20th, Mr. Harold Ramsbotham, the President of the Board of Education, formally declared open a new block of engineering buildings at the Derby Technical College. In the course of an address he revealed that as a result of a survey which was carried out some years ago into the needs of this country as regards technical education, a programme of expenditure on buildings for technical education had been begun involving a capital expenditure of £20,000,000. Although, he said, some progress had been made before the war, the cost to-day at pre-war prices to complete that programme would amount to between £12,000,000 and £15,000,000. After the war, Mr. Ramsbotham said, there would be an urgent need in the interests of commercial and industrial prosperity to ensure an improved system of commercial and technical training. As civilisation became more complex, and with the advance of science and engineering, the prospect facing the unskilled boy or girl would become, he thought, increasingly dismal. While, no doubt, there would be in all civilised countries hewers of wood and drawers of water, the demand for such services and the value put upon them were likely to diminish as development took place in engineering and electrical science. Speaking on the training of young employees, Mr. Ramsbotham stated that the number of firms which released their young employees for further training and instruction during the daytime was still pitifully small. He made an appeal to engineering employers to take full advantage of the facilities available for technical education, adding that he was convinced that they would find the result well worth while, not only to the industry but to their employees. In the year 1938, which was the latest year for which returns were available, the number of young employees released for technical training in the daytime was 41,000. It was of interest to recall, Mr. Ramsbotham said, that the earliest instance of daytime release was in 1900 when part-time day classes were started by the old Midland Railway Company, and some fourteen students attended those classes.

Mercantile Shipping Losses in May

ON Friday, June 20th, the Admiralty made known the official figures for the losses of mercantile shipping by enemy action during the month of May. They include 98 ships of 461,328 gross tons, of which 73 ships of 255,032 tons were British, 20 ships of 92,201 tons were Allied, and 5 ships of 14,095 tons were neutral. It is noted that included in the figures quoted above are the losses which were suffered in the Eastern Mediterranean during military operations. The Germans claim to have sunk during the month of May 805,460 tons of shipping, while the Italians have been content with a claim of 56,000 tons, making a total enemy claim of 861,460 tons. With regard to enemy losses, it is estimated by the Admiralty that the total enemy tonnage lost, either by capture, sinking, or scuttling, during the period up to June 10th is German tonnage 1,888,000 and Italian tonnage 1,239,000, to which must be added 84,000 tons of shipping useful to the enemy, making a total of 3,211,000 tons. As the statement which was dated May 10th showed a loss of 2,912,000 tons, the enemy during the intervening monthly period has suffered a loss of 299,000 tons. In consequence of information newly received since the previous statement was issued, some adjustments have now been made to the already published monthly totals quoted in a Journal note of May 16th. The increase in the figures for April, it is pointed out, is due mainly to further losses in connection with the evacuation from Greece, the bulk of the tonnage so lost being Greek.

Month of loss.	British.		Allied and neutral.		Total.	
	Ships.	Gross tons.	Ships.	Gross tons.	Ships.	Gross tons.
1940.						
July	68	284,770	36	115,583	104	400,353
1941.						
January ...	41	205,473	18	104,258	59	309,731
February ...	68	264,523	19	75,310	87	339,833
March	83	338,105	39	167,645	122	505,750
April	71	338,186	63	243,065	134	581,251

Town Planning and Post-War Reconstruction

IT was announced by the London County Council on Tuesday, June 3rd, that at the next meeting of the Council, to be held on Tuesday, July 1st, a report of the Civil Defence and General Purposes Committee will be submitted dealing with the evidence submitted on behalf of the Council to the Expert Committee on Compensation and Betterment (Uthwatt Committee), which was appointed by the Minister of Works and Buildings in January last. On the subject of town planning the L.C.C. Committee recommends that outline plans should be made during the war, subject to revision in the light of events, to which post-war redevelopment, reconstruction and improvements could be made to conform. The London County Council is, it states, at the request of the Minister of Works and Buildings, now engaged on the preparation of a provisional plan for the county. Planning of post-war reconstruction should, it says, be carried out in respect of a much wider area than that of, say, the County of London. Existing planning legislation, it considers, is inadequate and unsatisfactory chiefly owing to the lengthy and complicated procedure involved in town planning and in obtaining possession of land for town planning improvements, and insufficient powers of control. It is suggested that the appropriate Minister should be enabled to approve some form of town planning for operation without delay and without compliance with the dilatory and complicated procedure of the Town and Country Planning Act; rebuilding or redevelopment without the authority's consent should be prohibited until such time as a scheme is operative; and difficulties caused by existing statutory rights to rebuild on old foundations or to the same cubic extent, and as to user of buildings on land contrary to planning proposals, should be removed. Amendments of the Town and Country Planning Act are recommended, in addition to those involved in the above general recommendations, providing, *inter alia*, for town planning to be obligatory in all localities; for no development to take place without prior consent of the planning authority; for the inclusion in the provisions of a scheme of the siting of buildings; for power to secure maintenance and prevent alterations and additions, as well as destruction, of buildings of special architectural or historical interest; for power to exercise control over the use of land similar to that given over the use of buildings; and for the provisions of town planning schemes to apply to all land, including that owned by the Crown, Government Departments and statutory undertakings. The general conclusion of the Committee is that, in view of the large and concentrated amount of work involved, reconstruction, with any desired replanning, cannot be achieved with the necessary speed by existing processes or procedure; it can be carried out successfully only if public authorities have greatly enlarged and improved powers, which must be freely exercised, of control over land and buildings, and of compulsory acquisition.

Electricity Undertakings and War Conditions

IT is announced by the Electricity Commissioners that the Minister of Labour and National Service has agreed to bring the electricity supply industry within the field of the Essential Works (General Provisions) Order, 1941. The scheduling of electricity undertakings is to begin at once, and a list of electricity undertakings in the various Regional Areas has been prepared by the Commissioners and forwarded to the Ministry. The Divisional Controllers of the Ministry will shortly commence to schedule the undertakings and to issue continuing or provisional certificates. No applications by individual undertakers for entry in the schedule are necessary either to the Commissioners or to the Ministry of Labour. With regard to the extent to which the Electrical Installation (Restriction on Engagement) Order, 1941, applies to the operations of electricity undertakers, it has been agreed between the Ministry and the Commissioners that as an electricity undertaking is mainly concerned not with the installation, maintenance or repair of electrical equipment, but with the supply of of electricity, the Order does not apply to the undertaking as a whole. While most undertakings are engaged to some extent on installation, maintenance and repair work, when this is part of the work of the staff mainly engaged on the supply of electricity, then the Order does not apply to any part of the undertaking. If, however, there is a special branch or department of an electricity undertaking which is mainly engaged upon installation, maintenance or repair work, then the Order applies to that department.

The Glen Affric Power Scheme

IN a Journal note which was published in our issue of June 6th, we made reference to the opposition raised at the annual meeting of the Association for the Preservation of Scotland, to the Bill which was introduced into the House of Commons on Thursday, June 19th, by Mr. Johnston, relating to the Grampian Electricity Supply Company's proposed hydro-electric scheme in Glen Affric, and some of the neighbouring glens in Inverness-shire. It is termed the Grampian Electric Supply Company Order Confirmation Bill, and it is required under the procedure governing Scottish private legislation to introduce such a Bill in order to confirm a provisional order. By complying with the statutory obligation, however, no implication is made that the measure enjoys Government support, and so far no indication has been given on the attitude of the Government in this matter. Inside the House, however, the outside opposition to the scheme has already made itself felt, and a motion, it is announced, has been tabled by Mr. E. H. Keeling, who is supported by five other Members of Parliament—Mr. Neil Maclean, Mr. Bossom, Mr. Graham White, Mr. H. Strauss, and Mr. Denman. The motion proposes the rejection of the Bill in the following terms:—"That this House, while giving due weight to the decision of the Commission which held an inquiry in Scotland, declines to read a second time a Bill for confirming a scheme which is contentious, disturbs the national unity, cannot be carried out during the war, and may not be suitable or beneficial in the unpredictable conditions prevailing after the war." The Bill was read the first time and no detailed discussion took place. It will be read a second time on the first sitting day after Saturday, June 28th.

The Potato Products Industry

BECAUSE of the war the British Government has become greatly interested in what can be got out of a potato, and two potato products factories are already in existence—one at Wisbech and the other at Skelmersdale—while four more are in course of erection. Products from potatoes comprise chiefly flour, starch, dextrine, glucose and alcohol. In several European countries these industries are already well established, their progress having been materially assisted by various forms of subsidy from their respective Governments. With the increased agricultural activities in this country it should soon be possible to have an abundance of potatoes for manufacturing purposes after the normal domestic demands are supplied, although prior to the present war we were scarcely growing sufficient to meet these demands. The *Schwarzbrot* (black bread) of the Germans is made entirely from their home-grown potato flour, and while its appearance and flavour are inferior to our wheat-flour bread, the nutritive value of the two is said to be nearly the same. One acre of land will yield 1 ton of grain or 5 tons of potatoes, and allowing for the extra amount of water in the tubers, we get 30 cwt. of potato flour per acre against about 15 cwt. of wheat flour. Since it is possible to use up to 25 per cent. of potato flour in admixture with wheat flour without greatly affecting the quality of bread or pastries made from it, the production of potato flour in this country becomes an interesting proposition, particularly in war-time. Imported potato starch (farina), dextrine, and glucose are widely used here in the food and textile industries; while power alcohol can be made more cheaply from home-grown potatoes than from imported molasses. The significance of the potato as an industrial raw material is exemplified by the fact that in May, 1940, the Germans restricted domestic consumption of potatoes to 4 oz. weekly per person, although their acreage sown with the tuber is said to have been practically doubled.

Potato Flour

Potato flour differs from farina in that the flour contains both the peel and the internal fibrous portion of the tuber, whereas the starch has been carefully extracted from the fibrous matter. In producing the flour, the potatoes are first washed free from all soil, &c., then steamed for about 30 min. under a pressure of about 10 lb. per square inch, after which they pass through a disintegrator to convert them to a pulp. A sketch of a plant, by F. Jahn and Co., for converting the pulp to flour is seen in Fig. 1. The pulping machine delivers the pulp from the floor A into a tank, from which the rotary pump B sends it in a constant stream on to the top of two rotating drums C. These are 10ft. long by 4ft. diameter, and are steam heated at a pressure of 80 lb. per square inch, which gives a temperature high enough to sterilise the pulp and also to dry it down to a powder within a few seconds. When the film of pulp on the drum

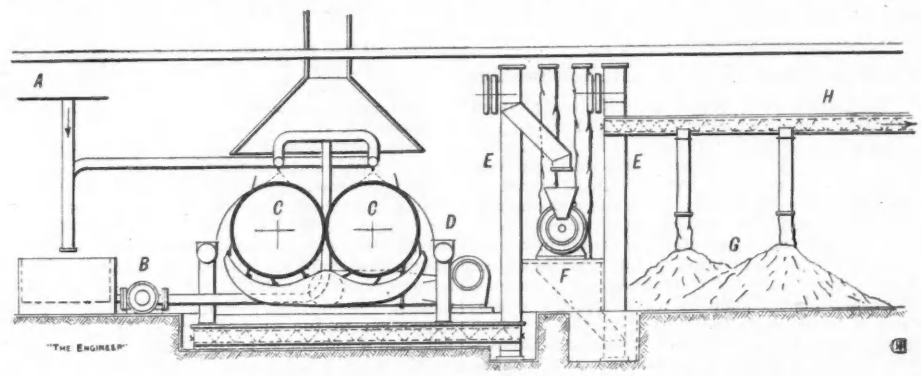

FIG. 1—PLANT FOR CONVERTING PULP TO FLOUR

surface has made practically one revolution, it is caught by scraper knives D, which peel it off the hot surface in the form of flakes, to drop into a worm conveyor under the drums. An elevator E then delivers it into a dry-grinding and sifting machine F, the fine powder thus produced being picked up by the second elevator E and conveyed by a horizontal worm conveyor H either to adjacent sacking chutes G or to store. In most cases the steam-heated drums are constructed of cast iron specially selected to withstand the steam pressure, and their surfaces are highly finished and polished, but are always without any form of plated covering. The drums may be fitted to rotate either inwards or outwards, the latter direction having the advantage of automatically throwing off any hard substance that may fall between the drums before it can damage their surface. A series of distributing rollers can be fixed lengthwise along the drum

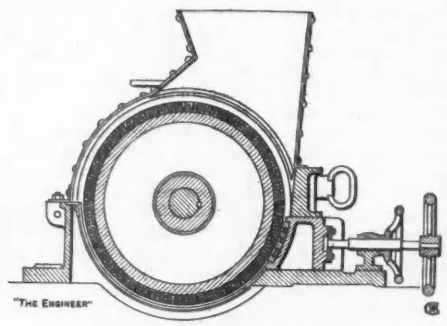

FIG. 2—RASPING MACHINE

surface to aid in evenly spreading the wet pulp in much the same way as the rollers distribute the ink on a printing machine. The scraper knives are of specially hardened steel, and may be adjusted to operate on any part of the drum surface or at any required distance from it. According to the rate of feeding of the drums with wet pulp and final moisture content required, the speed of the drums can be regulated. The water vapour coming off the drums from the wet pulp is drawn up into the overhead hood by an extraction fan, and as the vapour condenses the water trickles into gutters arranged around the inside of the hood.

Potato Starch

For the purpose of starch extraction, the washed potatoes are first put through a rasping machine such as that outlined in Fig. 2, made by Jahn and Co. This machine comprises a steel cylinder, to the surface of which is bolted a series of serrated blades, their length and size closely resembling a hacksaw blade, having about twenty teeth to the inch. The blades fit into slots formed by cross bars of steel of ¼in. width, and are sunk so that only the teeth appear above the drum surface. The shaft runs in ball bearings at a speed of about 1000 r.p.m. An average machine has a cylinder of about 20in. diameter by 12in. blade width, and will handle 50 tons of potatoes in twenty-four hours. As the tubers are fed to the hopper above the drum they are forced against the serrated drum surface by two or more steel blocks, which are adjustable through hand wheel screws, but they cannot be advanced sufficiently forward to touch and smash the teeth. It will be obvious that a stone or other hard object getting into the hopper would instantly destroy the serrated surface, so that great care is always taken to avoid this. When the blades have done several days service they are reversed, because they become bent in one direction through use. A sharpening device may also be fitted to the machine by removing the blocks and this sharpens the blades as the drum rotates. Although the rasping machine converts the potatoes to a relatively fine pulp, it is not fine enough for efficient starch extraction, for after a certain particle size is attained the teeth cease to disintegrate the pulp further and the latter merely escapes between the teeth. In some factories this coarse pulp goes through a second rasping machine equipped with finer teeth, but in general the final reduction of the pulp occurs in some form of stone mill, which may be of the vertical or horizontal type. The essential difference between the rasper and a mill in reducing effect is that the rasper works by a tearing action and as such it has a much bigger output than a stone mill, but the rubbing action of the mill is practically necessary to disrupt the minute starch cells so that the starch may be washed out by water.

The starch may be washed out of the pulp either by means of reciprocating sieves or in a rotary starch extractor such as the Jahn machine seen in Fig. 3. This consists of a cast iron framework supporting a cylinder built up of a number of perforated sheet copper or copper gauze sieves. Through the centre of the cylinder is fitted a shaft with radial arms, to which are bolted four paddle boards having brushes at their outer edges adjusted

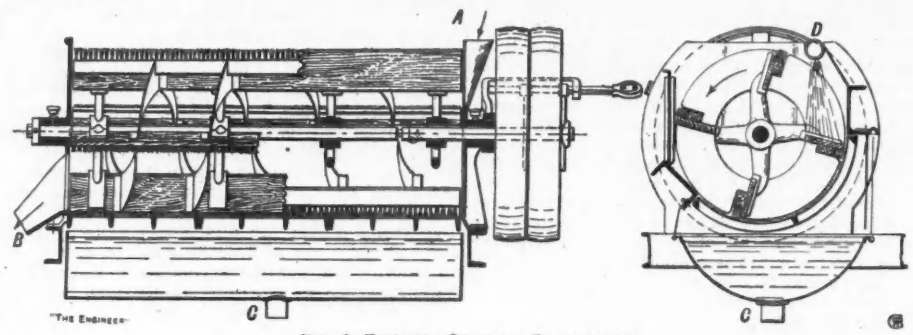

FIG. 3—ROTARY STARCH EXTRACTOR

to sweep lightly over the sieve surface. A steel spiral is also fitted to the paddle shaft to convey the pulp slowly through the cylinder. As the shaft rotates the four paddles in turn lift the pulp from the bottom of the cylinder and bring it into contact with strong jets of water D, dropping it back again as each paddle reaches the top of its travel. The pulp, diluted with water, runs into the machine at A, the fibre portion removed from the sieve by the brushes and conveyor spiral passes out at B, and the starch and water pass through the sieve and out at C. A machine of this type will handle about 20 tons of pulp a day. In most cases it is necessary to put the starch obtained from this machine through a similar machine having finer gauze sieves to separate residual fibre which has passed the first sieve; while the fibre from the first machine may be reground to recover its starch content.

The next stage is to separate the water from the starch, and as mechanical dehydration is cheaper than thermal methods as much water as possible is got rid of by mechanical means before placing the starch in a dryer. The older type of starch factory still employs long slightly inclined tables or troughs, upon which the starch liquor is run slowly at the upper end, the starch gradually depositing itself on the table surface, while at the lower end of the table clear water runs off. Starch deposited on a table in this manner still has a moisture content of 45 to 50 per cent., which means large-capacity dryers having to be used to remove so much residual water. On the other hand, when the starch liquor is put through a modern centrifugal machine the starch can be dehydrated to between 28 and 30 per cent. moisture, which makes much less work for the dryers. It is true that the centrifuges need power to drive them, whereas the tables use no power, but this is more than counterbalanced by the bigger output of the centrifuges

and the lower water content of their product. Fig. 4 depicts a modern centrifugal machine, by Pott, Cassels and Williamson, of Motherwell, Scotland. A novel feature of this type of machine is that it is carried on a special "float" plate, which in turn is suspended at three equidistant points on vertical bearing posts in which are encased steel bearing spindles with a rubber buffer at the upper extremity; this buffer resting in a corresponding seating in the bearing post, which reduces noise and vibration. Another new feature is that the motor driving the machine can be coupled direct to the spindle of the centrifugal drum, this spindle being an extension of the motor shaft. This arrangement allows the motor to swing in a natural manner with the centrifugal drum, although the oscillating tendencies of the drum

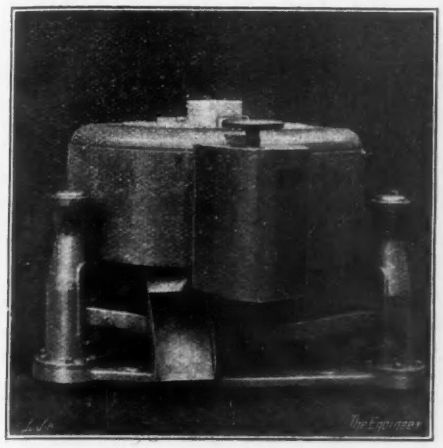

FIG. 4—CENTRIFUGAL STARCH DRYER

when carrying an unbalanced load are considerably curtailed by the new method of suspension. The motor is cooled by air drawn in under the float plate, the rotor acting as a fan and discharging the heated air at the top end and below the bottom of the centrifugal outer case. For handling potato starch the revolving drum, which is 4ft. diameter, would be made up of perforated sheet copper or bronze and covered with a layer of filter cloth. The cover over the drum is interlocked with the motor switch, brake and drum spindle. Thus the cover cannot be raised while the machine is running and the latter cannot be started with the cover open. Where available shafting already exists the direct-coupled motor can be dispensed with and the usual various forms of belt drive applied. A type of centrifuge by Jahn and Co., much used in German potato starch factories, is outlined in Fig. 5, its chief feature being that it incorporates a device for emptying the machine without stopping it. This

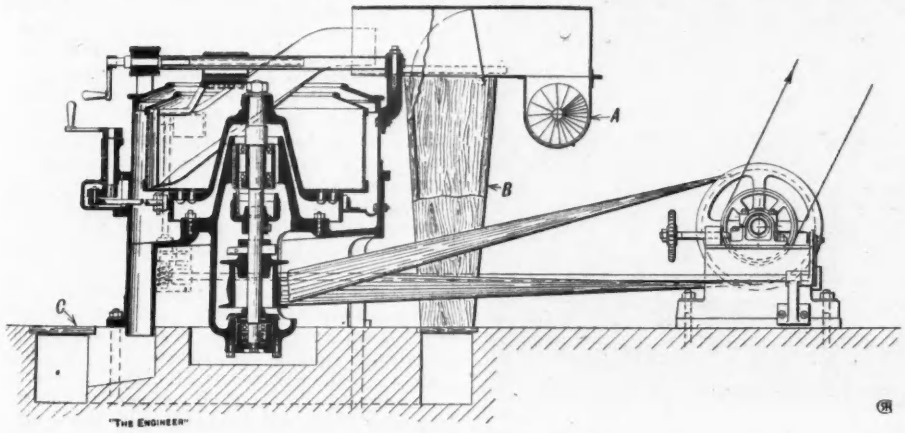

FIG. 5—ARRANGEMENT OF CENTRIFUGE

feature permits of a greater output for a given size of machine, because it can be continuously operated, and power is saved because no excess is used in constantly starting up. The drum spindle is anchored at top and bottom, running in ball bearings, while the brake acts on the underpart of the drum, so that its sudden application does not affect the spindle. In operating the machine the drum is set in motion and starch liquor run in. By centrifugal force the starch particles are instantly flung against the cloth-covered sides of the drum, whereon they form a layer. Any fibre which has passed the previous sieving operations forms a layer on top of the starch, meanwhile the separated water swirls round near the centre of the drum. By opening a valve this water is released into the gutter C, and when this is clear of the drum a hand screw, connected to a blade dipping into the drum, is operated so that the blade skims off the outer layer of fibre or "slimes." This slime passes up the chute and into the T-shaped collector at the right of the machine. In the centre of the T cross piece is a trap door in the base. When this is opened the starch outlet is cut off and the slimes outlet opened, causing the fibre to pass down the chute B for reworking. When the chute and collector are clear of slimes the trap door is closed and the blade in the drum brought down almost on to the cloth surface to remove the good starch which is passed out through the worm conveyor A to the dryers. The drying of starch follows the principle applied to similar materials, the plant for which is well known and needs no comment here. Farina is the name given to the dried starch after grinding and sifting, and it comes on the market as a fine lustrous powder.

POTATO DEXTRINE

Dextrine is a material intermediate in its chemical character between starch and glucose, and very often both these products are present in commercial dextrine, not because starch and glucose have been added to the dextrine, but because they are members of the same family and not easy to separate. The appearance of dextrine and starch is very similar, and the main difference lies in the solubility of the two, starch being practically insoluble in cold water, whereas dextrine is, or should be, entirely soluble. This soluble property of dextrine enables it to be used for many purposes for which starch itself is not suitable. For example, the British textile trades use thousands of tons of dextrine every year for sizing and dressing fabrics. Similar quantities are used by the food industries in which a cheap and soluble filling material is required, while amateur home decorators use it in the guise of cold-water paste for hanging wall paper. Until quite recently the production of dextrine was accomplished by roasting starch at a temperature of 200 deg. Cent. or more, which gradually rendered the starch soluble, but at the same time discoloured it. More recently it has become customary to acidify the starch first, and this acidified product can be dextrinised at a much lower temperature, and in a shorter time without losing its colour. As the proportion of acid—generally hydrochloric acid—used for acidifying the starch is always well under 1 per cent. of the weight of the starch, it is not a simple matter to distribute it uniformly throughout such a bulk of starch, but quite good results can be obtained by using an atomiser in which the acid is divided up into minute particles by air pressure. Three chief types of atomiser are in use. One is the jet pattern in which the acid—contained in a small pressure vessel of bronze—is forced by compressed air through a small orifice. The disadvantages of the jet atomiser are that the orifice tends to get clogged up, requiring frequent clearing, and the constant friction of the acid through the orifice widens it and ultimately renders it useless. A disc atomiser embodies a rotary disc having angular projections at the periphery, and the acid, under pressure, is directed on to the centre of the revolving disc, being projected from the periphery. In a third form of atomiser, the acid is forced upwards into an inverted cup or bell which throws it out again in the form of a fine spray, and in this type there are no small apertures to clog or to wear out. Two kinds of vessels, by Pott, Cassels and Williamson, used in dextrine making, are illustrated in Figs. 6 and 7, being an acidification vessel and a pair of roasting vessels respectively. The acidifier is of 2 tons capacity, having a body of Oregon pine wood to resist the action of the acid, the ends being of cast iron treated on their interior surface with an acid-resisting coating. A shaft to which is fixed a triple spiral runs lengthwise through the lower part of the vessel, being belt-driven through gears at the end, which arrangement effectively churns up the starch powder, while an atomised spray of acid is projected into it from an atomiser fixed under the top cover. The vessel is emptied by opening the aperture in the base through the hand lever. In the dextrine works the acidifier would be either placed immediately above the roasting vessels (Fig. 7), or alongside them, in which latter case a screw conveyor would be introduced between the outlet of the acidifier and the inlet to the roasters. These vessels—each of which holds 1 ton of the acidified starch—are jacketed, having copper shells, cast iron bottoms, and steel vertical shafts, with specially designed stirrer blades. Hot air, not steam, is the heating medium, this being created by a blower and a coke furnace. In the roasters the starch is first slowly dried at a moderately low temperature, for rapid initial heating would hydrolyse the starch, causing a high proportion of glucose to form; but the slow heating gets rid of the moisture and the acid vapour which would bring about such hydrolysis at elevated temperatures. When these vapours have

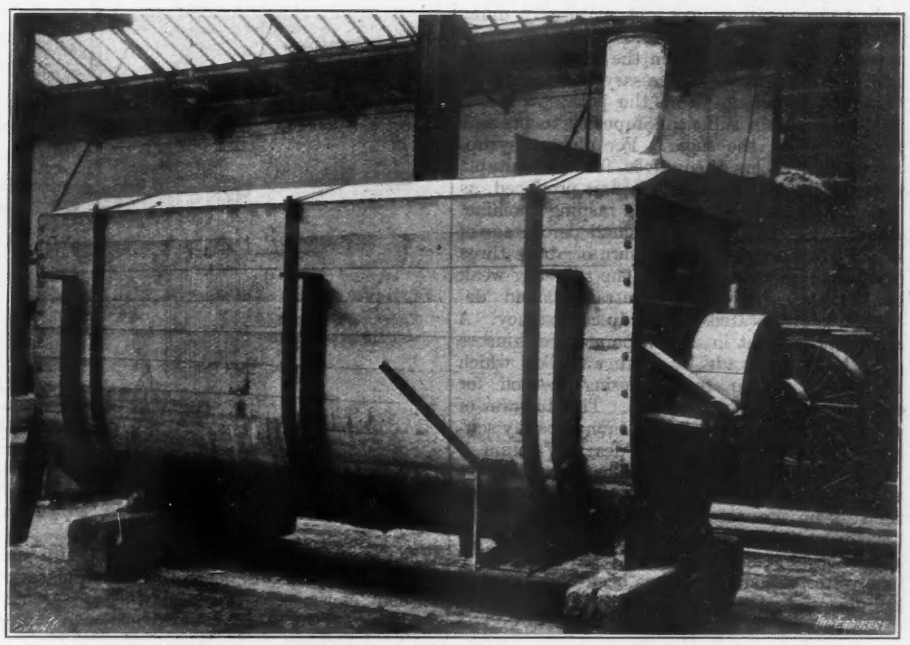

FIG. 6—ACIDIFICATION VESSEL FOR DEXTRINE MANUFACTURE

been driven off, the temperature is increased to between 140 deg. and 150 deg. Cent., by speeding up the blower from the furnace and increasing the draught on the latter, and maintained at this for one hour or so. The dextrine so formed is next cooled by transferring it to a horizontal cylindrical vessel with an agitating spiral and a cold water jacket. To produce a fine powder from the dextrinised lumpy material it is necessary to grind and sift it.

GLUCOSE

A general outline of the production of glucose has already appeared in these columns (THE ENGINEER, November 24th, 1933), and its manufacture from potatoes does not materially differ from the processes therein described. It may, however, be stated that when the crystal sugar is required, it is generally necessary to work from potato starch and not from the potatoes direct, since these contain sufficient impurity to prevent crystallisation of the sugar. For glucose syrup, however, the tubers themselves form a suitable raw material. A coarse pulp is first produced, as in starch making, by means of a rasping machine. The pulp is then mixed with a small percentage of acid and steamed under a pressure of about three atmospheres in an autoclave. The resulting weak sugar liquor, after being neutralised and decolorised, is evaporated to a syrup consistency. A recent improvement in the evaporation of glucose liquors has been made by Jahn and Co., which comprises a vapour recompressing method for economy in steam consumption. The diagram of a vacuum evaporator (Fig. 8), which is partly self-explanatory, illustrates the idea. Vacuum is maintained in the plant by means of a specially designed steam ejector, which creates high air velocity from the water-cooled condenser. Steam jet velocity is further employed as a thermo-compressor for entraining in its stream the bulk of the water vapour which has been boiled off the weak glucose liquor in the main body of the plant for use as heat in the same tubular body. This strong jet draw maintains vacuum for reduced temperature liquor boiling. Some of the vapour "bled" from the first evaporative stage may proceed to heat a second effect. Thus a small proportion only of the total vapour boiled from the liquor needs condensing by means of cooling water, colouring, flavouring, and seasoning—into so-called whisky.

In preparing potato spirit the raw material is a coarse pulp, obtained by rasping the washed tubers. The pulp is steamed under a pressure of about 40 lb. per square inch in an autoclave, which has the effect of gelatinising the starch and rendering it more suitable for the action of malt. The latter is similar to brewer's barley malt, but it possesses a greater diastatic activity by reason of slight variations in the method of its manufacture.

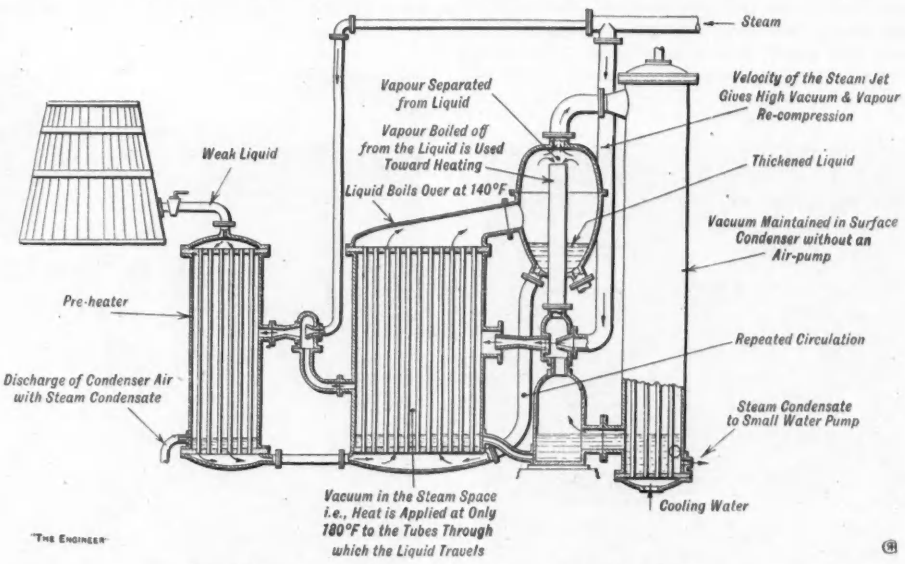
Steam
Vapour Separated from Liquid
Velocity of the Steam Jet Gives High Vacuum & Vapour Re-compression
Vapour Boiled off from the Liquid is Used Toward Heating
Weak Liquid
Thickened Liquid
Liquid Boils Over at 140°F
Vacuum Maintained in Surface Condenser without an Air-pump
Pre-heater
Repeated Circulation
Discharge of Condenser Air with Steam Condensate
Steam Condensate to Small Water Pump
Vacuum in the Steam Space i.e., Heat is Applied at Only 180°F to the Tubes Through which the Liquid Travels
Cooling Water
"THE ENGINEER"

FIG. 8—VACUUM EVAPORATOR FOR GLUCOSE MANUFACTURE

When malt is added to the gelatinised pulp, under specific temperature control, the amylase constituent of the malt breaks down the starch into dextrine. Two other active constituents of the malt—dextrinase and glucase—then convert the dextrine into a mixture of sugars, maltose, and glucose. From these sugars alcohol is produced by fermentation with yeast or other agent. The active properties of yeast are due to an enzyme, maltase, which converts maltose to glucose, and

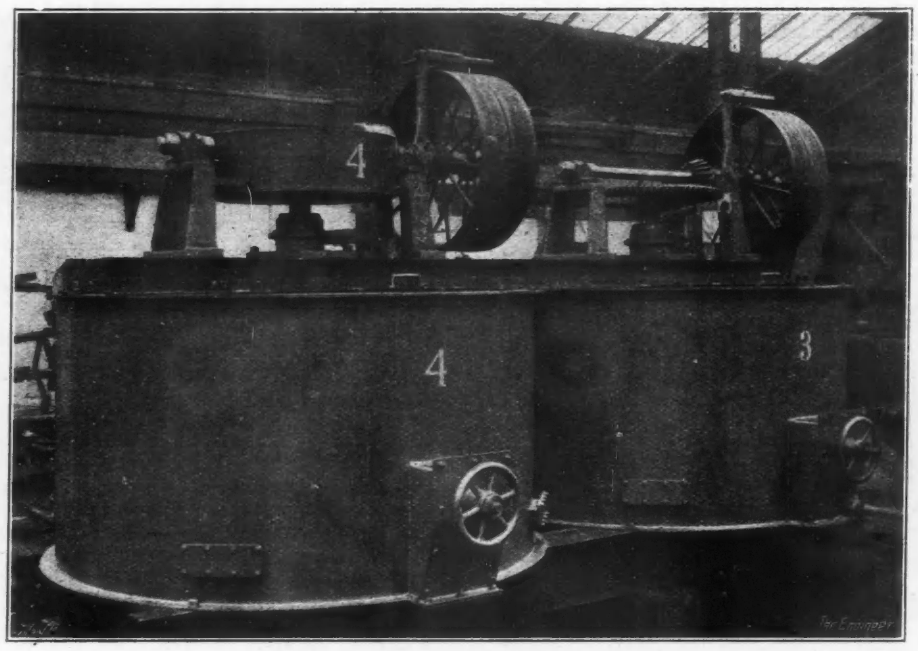

FIG. 7—PAIR OF DEXTRINE ROASTERS

and the amount of live steam from the boiler passing into the evaporator through the very small bore jets is reduced to a minimum.

POWER ALCOHOL

In several European countries the production of alcohol from potatoes has shown a marked increase in the past few years. Germany, for example, has more than doubled her output, and in 1938 she produced 150,000 tons from potatoes alone; while in Italy it is compulsory to mix all petrol with a certain proportion of home-produced alcohol. Before the demand for power spirit assumed such importance, a big proportion of potato alcohol distilleries on the Continent were producing potable spirits for conversion—by to zymase, which converts the glucose into alcohol. Yeast itself is capable of acting only on the sugars maltose and glucose, so unless the malt has previously done its work and completely broken down the starch, first to dextrine, then to sugar, some loss will occur. In practice, such loss does occur, for the theoretical yield of spirit is 56·8 per cent. of the starch in the pulp; but seldom is more than 51 to 52 per cent. obtained. The liquor resulting from the action of the yeast is known as "wash," and generally contains from 6 to 8 per cent. of alcohol. To separate the latter from the water and other constituents the wash is put through distillation columns which produce 97 to 98 per cent. alcohol in one passage of the wash through the plant.

As a motor fuel the trace of water found in commercial alcohol is not a serious drawback, for it does not appreciably affect the efficiency of an internal combustion engine. Vapour tension of the fuel is an important factor, and the presence of minute traces of water does not greatly affect this value. For example, at zero Centigrade and also at 10 deg. Cent., the vapour tension (in millimetres of mercury) of 100 and 90 per cent. alcohol is the same, viz., 12 and 24 respectively. But at higher temperatures the vapour tension of 90 per cent. alcohol is slightly lower than that of absolute spirit; at 80 deg. Cent. the figures are 810 and 782 respectively. Compared with petrol and benzol, the vapour tension of alcohol is very low; at zero Cent. the figures are:—Petrol (an average fuel), 46; benzol, 26; alcohol, 12. So that to run a petrol engine efficiently an alcohol alone several adjustments have to be made, such as adjusting the carburetter float to suit the specific gravity of the spirit. The latter also needs only about 60 per cent. of the air required for the complete combustion of petrol, while the compression pressure in the engine must be approximately doubled for alcohol. From tests carried out by investigators it is found that when an engine is properly adjusted to run on alcohol the latter fuel gives about the same efficiency and economy as petrol; but one big disadvantage of alcohol when used alone is that the engine must be heated by blow-lamp or other means when starting up from cold. Alcohol finds its chief outlet for power purposes in admixture with petrol, and about forty different countries now use it in this form, including Great Britain. For high-compression engines, as in aircraft, an alcohol-petrol blend is specially suitable, because it has a high anti-knock value and latent heat factor, which prevents overheating of the engine. In these days of heavy horsepower tax on car engines, an alcohol-petrol blend is advantageous, for the anti-knock is higher than the compression ratio needs of any make of car, and car manufacturers may by increasing compression ratios obtain a bigger output from a specific size of engine or cut fuel consumption by using a smaller engine.

A ton of potatoes with 20 per cent. starch content will yield about 25 gallons of 97 per cent. spirit, so that with potatoes at 40s. a ton, the tubers for a gallon of spirit would cost about 1s. 7d.; but at 30s. a ton the cost becomes 1s. 2½d. It would be necessary to add about 50 per cent. to this latter figure to cover manufacturing costs and a margin of profit, which brings the alcohol to 1s. 10d. a gallon. The necessity for a cheap supply of potatoes if potato alcohol is to compete with normal petrol prices is therefore obvious.

BIG ROPEWAY IN SWEDEN.—The longest ropeway in Europe and probably the largest installation of its kind in the world, taking into consideration its carrying capacity, is being constructed in Central Sweden. It is 28 miles in length and will have a transport capacity of 700,000 tons a year. This ropeway will be used for the transportation of limestone from the quarries to a new cement factory. Not only will the 550 wagons which are to be run on the line be conveyed without the use of human labour, but they will also be filled and emptied automatically. The pillars that are to support the line have all been erected, and the cable has been mounted over part of the stretch. Nordströms Linbaner is building the plant.

The Oil Situation in Russia

By "OILFIELD ENGINEER"

ALTHOUGH notes on the oil production in Russia were included in an article entitled "The Oil Situation in the Middle East," published in this journal on May 23rd, the opening of the Nazi offensive—fully anticipated in the article mentioned—renders a full survey of the Russian oil industry very interesting.

The total production of crude oil in Russia during 1939 was 30,000,000 tons—and the inadvertent error in stating Russian production, in our issue of May 23rd, as 4,433,000 tons is the subject of a correction in these columns.

Only a slight increase in output is estimated for 1940, owing to lack of modern drilling equipment with which to develop many areas which have been thoroughly checked by geophysical and geochemical methods as being potential oil-producing territory. It is this lack of good drilling equipment which has been one of the main reasons why the Nazis have not been able to obtain greater supplies of oil from Russia. Another reason, fully discussed later in this article, is that transportation facilities from Russia towards the European countries occupied by the Nazis are insufficient to carry greater volumes of oil.

The main thought in the minds of many people, however, when hearing of the German attack on Russia, has been whether the Nazis will gain further supplies of that lifeblood of modern war—oil. Careful consideration of this question results in the conclusion that although some small quantities of oil may fall into their hands, there is little or no possibility that the occupation of the main oil-producing areas of the Caucasus will result in Hitler gaining sufficient quantities of oil to enable him to carry on the war for an indefinite period.

Again we would stress the fact that crude oil is useless until it is refined, and that refineries are very easily destroyed. Invasion is no new experience for Russia, and the main reason for the retreat from Moscow by "invincible" Napoleon was that the retreating Russians laid the fertile country waste. The Russian forces—fully mechanised—and appreciating to the full the fact that the Germans must, over the majority of the 1800-mile-long fighting front, bring up oil supplies over long distances, will make a special point of destroying every oil storage depôt, every refinery, every oil well, together with equipment, which may fall into the hands of the Nazis, no matter how swift may be the advance of the Panzer divisions.

The lesson of France, when the Germans were able to advance with the aid of seized petrol and oil supplies, has not been lost on the Russians, who, it must be admitted, number among their virtues the ability to learn from others.

Some reports have stated that there are "vast stores" of petrol and of lubricating oil, together with diesel oil, scattered throughout the mechanised farms of the great Ukraine and Bessarabia cereal regions. Doubt is cast on such assertions by a report—now confirmed—first appearing in the *Schweizerische Zeitung* to the effect that an agreement to furnish 30,000 tons of petrol was signed between the Soviet Government and some Roumanian oil companies in March of this year. The petrol was required for Bessarabia and the Ukraine, and as soon as the agreement was signed the Russian tankers, "Zergo" and "Moscow," commenced loading at Constanza. It is considered that the Russians, fully aware of the fact that an attack by Germany might be made at any moment, have deliberately kept their oil storage in vulnerable areas to as low a level as possible, and the purchase of petrol from Roumania, for use in districts very easily reached by sea shipments across the Black Sea from the two great oil ports of Batoum and Tuapse, would certainly indicate that the Russians have little in the way of oil products to spare for export to Germany.

The quantity of over 30 million tons of oil per year is admittedly considerable, but the rapid growth of the use of Army mechanical transport, of the Russian Air Force, and of industries, as well as of domestic transport, calling for great supplies of oil products, makes this huge volume of indigenous oil output barely sufficient for domestic consumption, and for the building up of sufficient reserves for the great armed forces of the Soviet.

Even had transport been available for the shipment of larger quantities of oil to the Axis, it is obvious that the Russians would have had to sacrifice some of their own requirements to have shipped more than the estimated 500,000 tons per year of oil products to Germany.

Russian crude is generally of very high quality, producing a good lubricating oil and certainly better-grade petrol than can be obtained from the German synthetic oil plants or from Roumanian crude oil. It is believed that the exports from Russia to Germany covered mainly lubricating oil, of which vital commodity the Axis has been very short for many months.

TRANSPORTATION

The question of transport to Germany is well worth detailing, as, with the destruction of refineries in Russian territory overrun by the Nazis, the only way in which Hitler can hope to use the great quantities of crude oil which may be available will be for the crude to be sent to European refineries.

The German manufacturers of refinery equipment are hard put to it to cover requirements for repairs to the Axis refineries so thoroughly battered by the R.A.F. during the past year. There is, therefore, little prospect of the Nazis being able to

OILFIELDS IN RUSSIA AND MIDDLE EAST

transport refinery equipment over vast distances to occupied oil-producing areas, and thus refine the crude oil on the spot.

This point is well worth noting, as it means that the advancing German armies—should they succeed in penetrating deep into Russia—will have to rely on ever-increasing lengths of lines of communication, to keep their mechanised forces and *Luftwaffe* supplied with oil products.

In our article of April 18th regarding Roumanian oil, it was pointed out that although over 14,000 tons of oil products were produced in that country per day, less than one-half of this quantity could be transported to Central Europe, as the peacetime exporting point on the Black Sea, Constanza, handled 85 per cent. of the total oil products.

The transport situation in regard to Russia is very similar. Exports of oil and of oil products, which rapidly dwindled during the past few years owing to increased domestic demand, and inability to boost crude production, were made mainly from Batoum and Tuapse, both Black Sea ports. The map shows Batoum to be connected with the great Baku-Azerbaidjan oilfields by pipe line. There are actually two pipe lines connecting Baku with Batoum, one carrying crude oil and the other used for petrol refined in the Baku plant. Tuapse is at the end of the pipe line system commencing on the Caspian Sea at Makhachkala, and traversing the great oil belt at Grozny.

Both these ports were, of course, invaluable for the transport of oil across the Black Sea to Odessa, where there is a refinery, and to Kherson, a few miles from the Black Sea, on the banks of the River Dnieper, where another refinery is situated.

The railways of Russia—considered by some authorities to be overloaded to three times the traffic normally carried on British or American lines—can only handle part of the oil traffic from the Caucasus, the new fields of Romny and Poltava in North-East Ukraine, the Emba district, and from the Bashkiria and Izhma-Ukhta oil regions of the Ural-Volga territory. According to published estimates, railway tank car capacity on the Russian system amounts to around 500,000 tons, and the distances to be traversed, over crowded lines, must limit the annual oil tonnage carried by tank cars.

It is the inland waterway system, very highly developed, which carries the main load of oil supplies for domestic consumption, and those previously sent to Germany. Only two railway lines connect the oil areas of Russia with Eastern Germany, the route from Odessa *viâ* Lemberg, and the line from Rostov-on-Don, *viâ* Kiev and Lublin to Warsaw and East Prussia.

One waterway is up the River Bug to Brest-Litovsk, and another is up the River Dnieper, by canal to the River Pripet, and thence to Brest-Litovsk. These are the only routes by which river oil transport towards Germany could be made but they, like other Russian waterways, are frozen for almost six months of the year, and capacity is limited. Other water routes, for domestic oil supplies, carried by the Russian river tanker fleet estimated to have a total capacity of nearly 600,000 tons, are up the rivers Don, Volga and Ural. The Volga route, starting from Astrakhan on the Caspian Sea, goes *viâ* the Gorki canal, and the northern waterway network, to Leningrad, and thus serves the Baltic States, now part of the Soviet Union.

The comparatively long distances over which the river tankers and barges must travel, and the open season of not much more than two months, restricts the annual carrying capacity of the Soviet oil fleet, especially when one considers that an average round trip takes nearly two months.

It is therefore not difficult to see that the Nazis—should they succeed in occupying important crude oil-producing areas in the Caucasus—must also capture most of the river fleet intact, if the crude is to be transported to Germany for refining. It is possible that efforts may be made to ship crude across the Black Sea to Roumanian refineries, now operating at less than one-half capacity, but the difficulties facing the Nazis in transporting oil supplies in Roumania have already been fully detailed in these columns.

LEMBERG OIL

There is one oil area, under Soviet control, which may result in the Nazis gaining fresh supplies, and that is the former Polish oilfield region of Lemberg—reported to be the object of fierce German attacks. Most of the 7000 tons per day of crude oil—of good quality—produced from former Polish fields comes from many hundreds of small wells in the Lemberg area, in which there are also many refineries. The comparatively great number of producing wells here will be an obstacle in destroying all crude oil production near Lemberg, even though the refineries may all be demolished by the Russians, should they be forced back.

Crude from the Lemberg district will not have to be transported very far to refineries in Central Germany—should these plants not be destroyed by the reputedly formidable Red bomber force. This is the only point where the Nazis can hope to gain crude oil which can be of any real service to them in the prosecution not only of the Russian campaign, but of the war in general.

The surplus Roumanian products are, of course, of considerable advantage to the Germans in their attacks on the southern part of the long fighting line, but successful advances will mean lengthening lines of communication, and increasing difficulties in the supply of oil products to forces confronting opponents far more formidable than the Poles.

The Russians have planned their strategy towards the holding of a line in the Ural region, should they be driven back behind the River Volga. War industries, and vast supplies of oil products, have been concentrated in this comparatively remote area. In line with this strategy, the oilfields of the Ural-Volga area have been fairly well developed to provide a steady supply of oil products in the event of war against Germany.

THE CAUCASUS

The main oil-producing area is still in the Caucasus, but the details given show that occupa-

tion of this area does not necessarily mean that the Nazis are able to use the crude oil which may fall into their hands. Increasing domestic requirements, during the past few years, have called for intensive exploitation of the Caucasian fields, many of which were great producers long before the last war, during which so many British oil companies operating in Maikop, Grozny, and the Baku district were dispossessed. Deeper sands have been found in many of these old fields, especially on the Apsheron Peninsula. The structure was traced to Artem Island, in the Caspian Sea north of Baku, where considerable drilling has been done by rigs situated on the coastline, erected on special barges, or on substantial piling structures. By means of "directional drilling" rigs located on shore can penetrate formations lying beneath the sea bed, the drilling string being deliberately and carefully turned off, at a predetermined angle, and at a specified depth, by this now widely practised method.

The same sand, developed at Artem Island, has been found at Ilyich Bay, which is close to Bibi-Eibat, a name familiar to many with former interests in the Baku area. It is reliably reported that a well at Ilyich Bay was drilled to a depth of over 7000ft. last year, with an initial production of more than 200 tons per day.

This success proved up a considerable area along the shores of the Caspian Sea, and drilling operations have been carried out not only along the shore line, but also on rigs mounted on piling set more than a mile from the coast.

The Baku area comes under the main area named Azerbaidjan, controlled by one of the many Soviet Oil Trusts organised to handle the many vast oil-field districts. Further recent successes in Azerbaidjan are reported at Kala, and in North Surakhany, where a very high-grade crude—well known to oil men as "Surakhany White Crude"—has been discovered in deeper sands.

Siazan, on the Caspian Sea, is a comparatively new producing area of the Azerbaidjan Oil Trust. Reports state that the area is so vast that a new oil trust is being organised to handle the district. Crude with a very high petrol content has been found at Siazan, after exploitation work dating back to 1928.

Farther north in the Caucasus, Grozny is the centre of oil activity. Very steeply inclined formations retarded deeper drilling in this area, but new and ingenious drilling methods, based on "directional drilling," have enabled successful wells to be sunk to new low levels in a strata reported to be almost perpendicular. A very important new field at Oisunger, 40 miles east of Grozny, is reported, with a well producing 300 tons of high-grade crude oil per day from a depth of 5000ft. Being near the Makhachkala-Grozny-Tuapse pipe line, this new field has an outlet for the crude now reported to be produced from several good wells.

The main point of interest in Russian oil production is the Ural-Volga area, which will play a very important part in the war between Germany and Russia. Ivanova, near Moscow, and Penza, west of the Volga, were new fields opened up as the result of a producing structure found at Syzran, on the River Volga. A refinery has been erected at Syzran, on this most important waterway.

Between the Bashkirian area, which includes the important fields of Tuimazy, Sterlitamak and Ishimbaevo, linked by pipe line with the refinery at Ufa, and Syzran, a new oilfield at Buguruslam has been found. Reports state that considerable production of a good grade of crude has been found at very shallow depths, and that the producing area is considered to be very extensive.

The Emba region, near the mouth of the Ural River, in the southern part of the great Ural-Volga area, includes very productive fields at Iskine, Dossor, Makat, and Koschagil. A pipe line running from Gurlev, at the north end of the Caspian Sea, into which the River Ural runs, connects the Emba region with Orsk, a refinery town, near which the fields of the Akhtiubinsk area are also linked.

Ukhta and Izhma, up near the Barents Sea, are believed to be very important oil and gas producing areas, which materially assist in meeting the demands of the new industrial area which has sprung up in the Ural region.

In the Ukraine, oilfields at Romny and Poltava are now well established, and indications go far to show that North-Eastern Ukraine is likely to become one of the many important oil producing regions of the U.S.S.R.

Intensive surveys of the mineral wealth of the Soviet Union have resulted in oil being discovered at Nebit-Dag, in Turkmenistan; at Uzbekistan, in Mid-Asia; Tavdinsk, Siberia; Tolbinsk, Yakutia; Ayano, Sea of Okhotsk, as well as in many other areas. The domestic requirements of a Soviet Russia much more highly mechanised than at present, seem to be well covered by present and potential oilfields, and every credit must be given to the Russian Government for the manner in which hundreds of young engineers have received thorough training in all branches of the petroleum industry.

It is only the stupidity—not unknown outside Russia—which resulted in abortive efforts to employ the heavy industry for the production of equipment for oil drilling and refining, instead of purchasing such equipment from the home of modern petroleum development—the United States—that has retarded a more rapid expansion of the Russian oil industry, the eventual potentialities of which can only be the subject of speculation.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

A "GO-AS-YOU-PLEASE" TECHNOLOGY

SIR,—Two or three letters under the above heading, published in your columns during March, have greatly interested me. For some time I have realised the "untidy" state of the terms and nomenclature of the subject of strength of materials, and have in a small way tried to improve matters. It is therefore encouraging to know that others are thinking the same way.

The present state of the subject has its roots in the past, and is due, no doubt, to its piecemeal growth during the last two centuries. That is, however, no reflection on the pioneers who were exploring what was to them a new field, any more than it is a reason why we who are alive to the present need should not try to straighten things out. Those who are satisfied with the subject as it is and to whom consistency of names and terms makes no appeal, will not be interested in any case.

It seems that the terms calling for review vary considerably in their standing. They range from those whose meaning is well understood to others which, either from our failure to give them precise definitions or our lack of knowledge of the true character of their subject-matter, remain uncertain and vague in their meaning. Regarding this aspect of the matter, the following quotation from Trench, "Study of Words," is apposite:—"The success and enduring influence of any systematic construction of truth, be it secular or sacred, depends as much upon an exact terminology as upon close and deep thinking itself. Indeed, unless the results to which the human mind arrives are plainly stated and firmly fixed in exact phraseology, its thinking is to very little purpose in the end." Our aim in dealing with any particular part of the subject should therefore be to clarify our ideas on it, then to give it a well-defined name—either old or new, as the case requires—thereby fixing both the meaning and the name.

May I, however, without wishing to revert to the over-conservative, put in a plea for due consideration to be given before new terms are introduced; otherwise, we may, at the best, substitute terms which are no better, or, at the worst, perhaps from a multitude of counsel substitute one confusion for another. The clarification of ideas referred to above requires a fairly thorough knowledge of the subject. Things which appear as anomalies to the newcomer are not always so when better understood.

Coming now to certain details, why, may I ask, should we not be content to speak of hardness results as "Brinell (or ball) hardness" and "Vickers (or diamond) hardness," without the addition of either "number" or "stress"? The result is certainly not a number, but, while it has the dimensions of stress, it is by no means a simple stress. Another example of untidy nomenclature, not mentioned hitherto, is given in the usual designations of the elastic constants of tension and shear, *i.e.*, "Young's modulus" and "modulus of rigidity," the former suggestive of a proprietary article, and the latter that rigidity is a property peculiar to shear actions! "Tensile modulus" and "shear modulus" are self-explanatory, simple, and straightforward.

That brings me to certain requirements which, I submit, should be borne in mind when introducing new terms. They should:—

(*a*) Indicate their meaning.
(*b*) Be distinctive.
(*c*) Be concise.

All these requirements are exemplified in the above suggestions.

The expression "nominal maximum stress" has been put forward in place of "ultimate tensile stress." This substitution is to be preferred up to a point, but to make it distinctive the word "tensile" must be added, and then it fails to be concise. I fear that in these days of brevity and "clipped English," such changes may not find general favour.

While on the subject may I add that I am disturbed to find such a respected body as the B.S.I. perpetuating such an anomaly in connection with the hardness test as the P/D^2 ratio. This is akin to the power/weight ratio so beloved of engine builders. The word "ratio" is defined as a comparison of like quantities, is expressed by a number, and therefore cannot correctly be used in either of the cases mentioned.

The references by your correspondent Mr. Hugh O'Neill to Miss Elam's work requires some wider study before its implications are fully appreciated, but it is a reminder that the subject is never standing still. Terms and meanings fixed to-day may not suffice to-morrow. But we may hope that some will last long enough to have been of real value before they are discarded.

CHAS. H. HELMER.

London, S.E.10, June 4th.

ENGINEERS AND SCIENTISTS

SIR,—I write to you as the public upholder in many articles of the dignity and honour of the engineer. I am fed up with the public adulation given by Cabinet Ministers to the scientists, to the complete neglect of the engineer. Without doubt great honour is due to our scientists, but without the labours of the engineer their scientific discoveries could never be put into a practicable form in which alone they are of use to mankind, armed or disarmed. The trouble is, I think, due, as you have pointed out, to Cabinet Ministers and other vocal emanations of Government being surrounded by eminent scientists, headed by such obvious personalities as the President of the Royal Society, and these people having the ear of heads of Government, give undue prominence to the work of their own people. There is no vice in this, except that there is no body of prominent engineers to whisper into the other ear of Cabinets and high authorities the part taken by the engineers.

In short, there is no balance. It is like a combined warlike operation, where one arm alone is allowed to claim the full credit for the work of all three services. The Cabinet is most scrupulous in allowing all three fighting services to issue their own version of the operation, and so the public is able to form its own opinion of the relative parts played by each service in the satisfactory completion of the combined affair.

Such a course is not taken when a new weapon is produced, as instanced by the dope given out by Ministers and others in connection with radio location. Without engineers to turn the scientist's ideas into workmanlike machines and without the help of the technical services to operate the machines, there would be no means of utilising the idea against the enemy.

Engineers are involved throughout the development, otherwise there would not be supplies in sufficient quantities to meet the needs of the troops. They have to overcome great manufacturing difficulties, and make the idea work in practice under service conditions, and service transport difficulties. They have to ensure that the idea is produced in such a form that the available personnel can operate it under service conditions. Some of these engineers are military personnel, Army, Navy and Air; others are civilians. The clothes they wear cannot conceal the fact that they are engineers.

Then the military must take up the idea, and work out a system of operating it to the best tactical advantage. This means long planning, great organisation. The training plant or sets, the schools, and the collection of the right sort of personnel to train in the right places. A new technique may have to be worked out for operations in which the new weapon will be utilised. The military have a very big part to play in introducing the weapon, not the least of which is the time factor, *i.e.*, they must be ready in a fairly long-term programme to make the best and earliest

use of the weapon when it is placed in their hands. If they start to use it too soon when available, only in penny numbers, they may lose the element of surprise, *e.g.*, our first use of tanks. If they are too late and slow, the enemy may forestall them.

No, while the scientist has produced the idea of radio location, the credit of our being able to use it must be shared by both engineer and military, who have taken a long view of its possibilities since it was first brought to light.

Let us take as an example any war we entered equipped only with bows and arrows. In the early stages scientists discovered a substance called gunpowder, a material of which there was some slight scientific knowledge before the war started. Another group of scientists had discovered the effect of a high-pressure discharge through the blow-pipe used by certain Colonial troops. These two branches of science were brought to the notice of the head wagers of the war. Unless these latter had had the insight to visualise the potentialities of a new weapon which could emanate from the dual discoveries there might never have been rearmament during that war.

Fortunately, the military were receptive of new ideas; in fact, some were much too "wishful thinkers" and were all in favour of throwing away the bows that had guarded the country for years on the assumption that firearms would be flowing from the factories in streams like wheat from the next harvest.

Happily, wiser counsels prevailed. The scientists were told to run away and confer with the engineers as to the form the new firearm would take, how materials were to be found, how rifling machines were to be built, and whether existing bows could be turned into the butts of the new rifles. From these confabulations the pieces of string showing the scientific idea were converted into a practicable article that the troops would not break up in use and which would not clog up with mud in winter trenches and billets. Brutal touches by the practical engineers!

Then the factories, already full with orders for halberdiers' equipment, had to be turned over to the manufacture of the new arm in sufficient quantities for an offensive that would be dated by the exertions of the factory workers. Of course, little troubles arose to delay the new programme of manufacture. No one had ever made a sight before, and, believe me, these are mighty hard to make if one has only manufactured suits of mail before!

Then another troublesome scientist discovered ballistics, and the question arose, should the great offensive be delayed till this new science had been developed sufficiently, or should the weapon be fought in its stage of partial development?

Fortunately, the military put their foot down and said zero hour is zero hour. Keep ballistics up your sleeve for our next little war.

Meantime the military had to take their coats off to be ready to fight with the new rifle. First of all, were they to continue their planting programme for ash to build future bows? A long-term decision this. Next, new ranges had to be provided, since the rifle fired at 1500 yards instead of 150. Then a new class of operator had to be selected and trained. Strong-i-the-Arm had to be replaced by recruits with long-range eyesight for the 1500-yard weapon. Should bayonets be added to the rifle or should the halberd be carried as well? How soon could the old bowmen fight their new weapon successfully after its receipt? Who were to be taught to act as instructors? Should the scientists keep all their early models or should some go to the new training ranges?

Scientists alone? No. A team. Scientists, engineers and military. A team; each member his job. A trinity, with all that that implies!

June 23rd. R. E.

PREPARE NOW

SIR,—For what? The maintenance of our export trade and also for the post-war economic drive and the sudden and drastic change which is inevitable on the declaration of peace. Peace in hostility but not in trade. Those who are our helpers now will become our opposition.

The problem should be given full consideration without delay, so that the slump similar to our last can be avoided and therefore the unemployment averted as much as possible.

Stagnation has already been created in many of our prosperous peacetime trades, and therefore it is our duty now, in spite of war pressure, to find new stimulus and ideas for our national industries.

This could be greatly helped by the encouragement of every source of inventive talent and placing it before our industry through an unbiased channel. The work need not be put in hand at once, but contracts can be prepared ready to be put into operation at the right moment with the least delay.

This work should be done by the older brains of the country who are not keen on taking an active part in the conduct of the war, but who, through their past experience, are eminently suitable and would be only too willing to take on work of such national importance, especially as the results would expand further on the establishment of peace throughout the British Empire and therefore the world.

Such an organisation has been proved possible and useful, when it got the right backing, both in America and Japan. Japan's activities have luckily been diverted by war, as the results of their developments might have been worrying to us when the cost of their skilled labour had been set up against ours on a basis of mass production. In America the Mellon Institute is the organisation. This, since it received proper financial support, has done endless research for the benefit of invention and works in a colossal building, turning work away. A similar body could be formed in this country, which, if run on similar lines, could grow to a much greater size and become the nerve centre of the trade of the British Empire. Its members would be inventors and commercial firms who would be brought together by correspondence, interviews and exhibitions in our industrial centres, the result of which would so strengthen and elevate the position of the inventor in all classes that many more ideas would be put forward and our industry benefit accordingly.

Such exhibitions have already been held in our industrial centres and, in spite of the poor class of exhibit, generally have proved a success and created an interest. One held in Sheffield attracted an attendance of 30,000 in ten days and ran at a profit of over £600. It is true that only 10 per cent. of the ideas submitted are worth investigation, but every now and then one is found that creates a new or revives an old industry to the benefit of several thousands in a few years' time, thus making the rest of the investigation work worth while.

Preparing for the last war, the Germans knew the value and strength of inventive talent, as was shown by the Key Industries Exhibition held in Westminster afterwards. There were shown some of the essential items needed in wartime, such as magnetos for aeroplanes and lorries, heat-resisting glass for miners' lamps, optical glass for ranging instruments, tungsten steel powder for armour plating, &c., which were sold at a false value through secret Government subsidy to the rest of Europe for years before the commencement of hostilities, so that when the latter was launched their opponents would not be able to supply themselves with the additional quantities suddenly brought into demand by the expansion of war equipment without initial experiment and design carried out by the inventive brains of their countrymen. We had to mobilise our inventive talent during hostilities and discover and design these necessities, which we did under great difficulty. The results have remained better ever since, as has been proved by this war, but new ideas have had to be found again at short notice.

Such an organisation would not interfere with our existing organisations, but would soon work in co-operation with them, asking for their assistance and advice on standardised lines and submitting the results of its work to them for their investigation and the benefit and interest of their members. All our trades and professions would benefit likewise. An experimental station would be set up for the investigation, advancement or correction of new ideas, which would soon grow in size to become self-supporting financially.

The annual expense of such an organisation to start with would be under £10,000 per annum, and this sum would easily be covered by about four exhibitions per annum in various industrial centres and a membership of about 3000 inventors and firms on a subscription of £2 2s. to £5 5s. per annum, according to the services rendered.

Now is the time to launch such a scheme, especially as there is so much latent foreign talent in the country through evacuation and the stagnation of Continental trade, which could be used for the expansion of existing and the creation of new trades which would be establishing a great benefit both for the present and the future throughout this country and eventually the British Empire. ARROL MOIR.

June, 1941.

NAMING A NEW MINERAL.—The U.S. Geological Survey has announced the discovery in South-Western Wyoming of a new mineral, which has been named "Bradleyite," in honour of Wilmot H. Bradley, senior geologist in the Survey. It is described as anhydrous and composed of a one-to-one molecular ratio of sodium orthophosphate and magnesium carbonate.

Sixty Years Ago

HIGH-SPEED STEAMSHIPS

RECENT proposals for the construction of a fleet of high-speed Atlantic steamers, the launch of the "City of Rome" and the building of gigantic ships by the Guion and Cunard companies all pointed, so we wrote in our issue of June 24th, 1881, to a desire to place England and America virtually closer together than they then were. Most of the conditions to be fulfilled, we continued, were now perfectly understood. An average speed of at least 20 miles an hour was required. It was known that such a speed could not be realised with vessels of less than 5000 tons displacement and it was nearly certain that much more would be required. The express Atlantic steamer of the future would thus have to be a vessel of enormous engine power. At the same time, there were great difficulties in the way of utilising 14,000 or 15,000 I.H.P. at sea. While the conditions of success were known, the means of securing those conditions had not been settled. Froude had shown that eddy making and skin friction were responsible for very nearly the whole of the resistance of a ship. Those two factors depended very largely on the shape of the hull. It seemed probable that no further progress was possible in the direction of reducing the resistance of ships so long as we adhered to existing models. These comments led up to a description of a design of ship prepared by Captain C. G. Lundborg, a Swedish naval architect, which seemed to us to be full of promise. The main body of the ship, we explained, was designed to divide the water horizontally instead of vertically. To that end the cross section of the hull was deeply waisted below the water line. Above the plane of the waist the sides tumbled out. Below it they swelled outwards to extreme points, whence they returned sharply to form the curved bottom of the ship. The stem was of the clipper type. At the stern the underwater side bulges were thinned down and passing beyond the stern post merged together into a tapering horizontal fin which carried the rudder and the two screws. The ship would have an extreme length of 500ft., an extreme breadth of 74ft. over the bulges, a breadth of 56ft. on the load water line, and a draught of 24ft. Each propeller shaft would be driven by two compound engines, the total indicated horsepower being 22,800. It was anticipated that the ship would have a speed of 20 to 21 knots.

WELDED AFTER GALVANISING.—An American metallurgist has devised and patented a method of welding galvanised sheets and structural elements, regardless of size, whereby the joints are left in a rustproof condition. Hitherto, it has been impossible to weld without burning off the galvanising, thereby leaving joints subject to rust. The process provides for regalvanising at the time of welding. The resulting joint is rustproof because the regalvanising is done while the steel is cherry red, thereby taking a relatively deep penetration of the galvanising material into the steel.

RED CROSS AGRICULTURE FUND.—Manufacturers have presented to the Red Cross Agriculture Fund many products used by the farming community for sale by postal auction. We are glad to see that agricultural engineers have been very generous donors. A complete catalogue of all the gifts with the usual retail price for each item has been produced, but owing to the paper shortage it can only be sent to those who ask for it. Requests should be addressed to the Red Cross Agriculture Fund Committee, 30, Belgrave Square, S.W.1. Besides such things as herds of cattle, petrol engines, ploughs, sheep shearing machines, and so on and so forth, books and guns and things to "eat, drink and wear" are to be auctioned. The catalogue includes several amusing sketches by Fougasse, the originals of which are to come under the postal hammer.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The annual dinners held in pre-war days by the Institution of Automobile Engineers were always particularly pleasant affairs. That atmosphere was retained in a luncheon held on June 20th at the Savoy Hotel, London, W.C.2. Automobile engineers frankly enjoy themselves when they meet together, and among few other institutions do so many members seem to be well known to one another. The chief guest and the proposer of the toast of "The Institution" was the Right Hon. J. T. C. Moore-Brabazon, Minister of Aircraft Production, who had, it was revealed later, accepted the invitation, as Minister of Transport. He made graceful reference to Past-Presidents of the Institution, including Col. Crompton and Lord Austin, mildly criticised the stability and handiness of the modern car, recommending research on the subject, touched upon some early car designs, notably the Mercedes, and instanced the important part the development of metallurgy had played in making the modern car possible. He suggested that after the war the Government would need to take a new attitude towards motoring as a mass-produced system of transportation. In connection with aircraft, he suggested that after the war engines basically different from those for use in bombers would need to be developed if civil air transport was to become commercially possible on account of the high fuel cost. Nations were not going to pour money into civil aviation just for fun. In reply, the President, Mr. Percy C. Kidner, agreed that the stability of the modern car was not all that might be desired. But he sturdily upheld the ability of British automobile engineers to lead the world in design. The toast of "The Guests" was proposed by Mr. Frank G. Woollard, President-Elect, who expressed the hope that Moore-Brabazon might again become Minister of Transport after the war. Sir Leopold Savile, President of the Institution of Civil Engineers, made a suitable reply.

The Engineer

JUNE 27, 1941

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The Metallurgist.

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HIGH-FLYING AIRCRAFT

THE reported replacement of the German Me.109E fighter by a later model—109F—having a much higher ceiling, again focuses attention on the problem of high-flying aircraft. The new fighter has, it is stated, a greater wing span and a lesser armament. The former change, since it lessens the wing loading, and the latter, as it decreases the load to be lifted, will each have the effect of reducing the drag at all altitudes of flight, and if, as is also claimed, the engine power has been enhanced, there should certainly result an increase in the service ceiling, but whether this will carry the Me.109F to the 38,000ft. level, as reported, remains to be shown.

Fighters and bombers are very differently aided by increase in climbing capacity. For the bomber a higher ceiling makes it less likely that it will be hit by anti-aircraft guns (the smaller ones may even be unable to reach it), and what is more to the point, intercepting fighter aircraft will take so much longer to get to it that its opportunity for "tip-and-run" raiding will be facilitated. An optimistic designer might dream of a bomber able to fly higher than any fighters which pursue it, and so be free from attack. Such a dream would be quite unrealisable in practice, granted always that technical data were equally available to the designers of both types; unrealisable because the ceiling of any conceivable aircraft would be at once heightened if it had to carry no bombs and as little fuel as a fighter. Hence, the fighter is at an advantage and can always overtake the bomber, whether in speed or ceiling. For the bomber there is therefore not much gained in safety by flying high, and certainly much that is lost. It takes any bomb nearly a minute to fall to earth from a height of 35,000ft., and in that time its parent aircraft will have flown at least 4 miles and possibly 5 miles. Hence at the moment when the bomb aimer has to release his bombs, the target will be not less than 8 miles away on the diagonal, and is almost certain to be hard to recognise or, on many occasions, even to be seen at all. Moreover, an error in the course steered of as little as a degree to port or starboard must throw the bomb off its aim by at least 100 yards to one side or other of the target. The case for an increase of the fighter's climbing capacity rests on quite other considerations. At first blush it might seem that there could be little point in flying at a higher level than enemy fighters can attain, since there would be no one there to fight. That is not, however, the right way to judge the issue. The fighter with the higher ceiling is always at an advantage in that it can gain tactical speed by a sudden downward swoop on its opponent and cannot itself be followed when it flies up again to prepare for a further swoop. Again, no aircraft can manœuvre well when flying near its ceiling, and if it cannot manœuvre well it cannot fight well. The fighter with the greater climbing capacity still in hand will always be at an advantage—provided that sufficient attention has been paid during the development of the type to ensure the proper harmonisation of its controls. It is good to learn that the excellence of control in the new American fighters is much more than one could have dared to hope for. Ability to improve climbing capacity is therefore wisely directed at the fighter rather than the bomber, and this explains no doubt the German action, though it is satisfactory to learn, so far as current information goes, that our present-day fighters are fully equal to the new Me.109. Perhaps the latter aircraft was not really expected by its designer to be capable of outdistancing and outclimbing its British and American rivals, since it carries armour plate no less than ¾in. thick at the pilot's back. In thinking as much as one necessarily does of the contest between fighter and bomber, one is liable to overlook the work of the reconnaissance aeroplane, which is certainly greatly aided by the ability to fly high. At great altitude the atmosphere is steadier and the aeroplane is a better "gun platform," a merit especially valuable for aerial photography. But the craft must not be pushed too close to its ceiling or unsteadiness in control will result, and much of the merit of high altitude will be lost. But high flying may mean—for a while, at any rate—freedom from interference, and this is just what the work of photographic reconnaissance chiefly requires.

In the case of bombers intended for attack on military objectives, very great altitude is usually a disadvantage; almost its sole merit is gain in penetration and that is not usually a sufficient offset, sometimes, indeed a drawback. Hence, although we must be ready for high-flying bombers, the disadvantages associated with any extreme enemy effort in this direction would seem to be sufficient to prevent its general adoption. None the less, it is essential that we should press on with the technical development of our fighters, and so be ready for all events.

Government by Engineers

WHY is it that engineers take such a disproportionately small share in the public life of their country? This recurring question was recently brought forward again by an engineer, who, when addressing a meeting of engineers, lamented that there were not more of their number in direct, active, and close contact with the government of Great Britain. The special point of these remarks was their association with a well-deserved tribute to a professional engineer—Hussein Sirry Pasha—who is himself the Prime Minister of an Allied country. The speaker might have added that the present Egyptian Cabinet is exceptionally strong in technicians, for it includes also another engineer serving as Minister of Public Works and a geologist who is the Minister of Defence. It would require a prolonged search to find a parallel to this example. With the exception of President Hoover, one may doubt whether any other engineer in modern times has reached the highest position in the government of his nation. In Europe the best we can do is to make a mathematician, Poincaré, the President of the French Republic. Only a handful of engineers have been given Cabinet rank in our own country. If we begin with such names as Lord Weir, Sir Eric Geddes, and Lord Reith, we find that already we have nearly reached the end of the list. In the present Cabinet Lord Reith is the only engineer. Nor do military engineers in their more restricted sphere fare much better. Only two names, Kitchener and Gordon, come readily to the mind.

Is it the rule, then, that engineers are not fit to hold high offices of State, or do they not want to hold these offices? A professional body which demands such varied qualifications from those who aspire to join it will hardly admit that its members are inferior by any standards to men who have other aims in life. But is it not true that the more deeply absorbed an engineer becomes in his work, especially the scientific side of it, the less attractive other occupations become? He tends to withdraw into a simplified world of his own, from which blemishes such as greed, hate, fear, and cruelty have been eliminated. Flattery and anger are alike impotent, for the instruments he uses will not respond to these stimuli. Forgetfulness, stupidity, and weariness he circumvents by devising mechanisms that never grow weary and that never make mistakes. He does not have to yield to changes of fashion or waves of popular feeling, for although his views may change with changing years, he believes that the laws they seek to formulate will not change. To issue from this delectable retreat, in which work is so often an enchanting kind of play, and to face the turmoil, perplexities, and disillusionments of parliamentary life, involves very considerable sacrifices. Already the engineer's time is completely filled with the problems of his own profession, and so from the outset he feels at a disadvantage in comparison with competitors whose workaday occupation seems to have plenty of leisured intervals. Nor does it cease to appear odd to him that running a country should be a sort of spare-time job. If a long and specialised training was necessary for his own calling, how much more should it be essential for administering an empire? Yet he cannot silence the echo of unfriendly voices which reproach him with bestowing upon mankind destructive powers unaccompanied by most stringent "instructions for use." Must he accept more than the common share of responsibility for the condition of the world today? Must it be only when the world is finally in ruins that he will emerge, as foreseen by Mr. Wells, a veritable *deus ex machina*, to set it right?

Although, then, engineers will continue to be gratified when one of their number is granted high administrative office, they will hardly expect that this will happen more frequently in the future than it has in the past. The fact that a young man has decided to become an engineer is itself evidence that the prizes of political life will not glitter for him. And when reconstruction begins, the immensity of the work the nation will demand of him will put it out of his power to diverge into sidelines. But, as a private citizen, his particular gifts and training can be utilised with most salutary effect. By trying to infuse into everyday life the traditions of responsibility, accurate observation, and informed criticism, that are indispensable in his own work, he can help his associates to keep in touch with reality, and it is to be hoped that in some manner means will be found after, if not during, the war to enable engineers to influence the opinions and decisions of legislators.

On Inventions and Patents

(Contributed)

THE use of the word "patent" as applied to an invention arose, at the outset, from the circumstance that the document granting exclusive rights in an invention was orginally a Letter Patent issued under the Great Seal and, as such, recorded in the Patent Rolls. These Patent Rolls, or Records, contain particulars of such documents as were to be open, or "patent," not only to the person or persons to whom they were addressed, but to all persons to whom they might come. The Patent Rolls—like the Close Rolls—were among the Chancery Rolls cared for in early days by the Master of the Rolls, and they are extant from the opening years of the thirteenth century. Since 1853, however, letters patent relating to inventions have been entered, not in the Patent Rolls, but in a register kept for the purpose at the Patent Office.

It will be agreed that there is a mighty difference between the vast majority of what are commonly called "patents" and the comparatively few manifestations vouchsafed to mankind in the form of specific inventions. Dr. Johnson has remarked, with singular emphasis, on the character of the energy put forth in "the production of something, where nothing was before." He presses, indeed, the great distinction between the energy of this act and the energy required in "the expansion or decoration of the thing produced." It is "the expansion or decoration of the thing produced" which keeps the Patent Office so busy and, incidentally, finds so much profitable employment for the legal profession and for that worthy and numerous body known as patent agents. The question as to whether a real inventive step has been taken in any application for a patent is not decided by the Patent Office. This fact is doubtless unknown to the majority of those who are asked to provide funds for the exploitation of alleged inventions.

A saying which might well be remembered by those in whom patentees are quick to discern the lineaments of credulity fell many years ago from that great exponent of patent law, Mr. Fletcher Moulton, afterwards Lord Justice Fletcher Moulton. He remarked, in the course of certain litigation directed to the revocation of a patent for valve gear, that the said patent "was invalid for the weightiest of all reasons: a radical want of novelty in the alleged invention." Those whose business brings them to the serious study of patents and patent law have usually good reason to appreciate this and many other rulings, and to realise how ambiguity, that slip-shod parent of litigation, can range from the merely slovenly to the definitely fraudulent.

A judgment which greatly impresses by the clarity of its definition in respect of obscurity and ambiguity was that uttered many years ago by Lord Chancellor Loreburn, in an appeal brought to the House of Lords respecting a specification concerning multi-colour cinematography. Lord Loreburn, in addition to pronouncing the patent bad for certain reasons, found against it in the court below, added the following remarks on ambiguity: "He wished to observe that quite apart from these grounds, he thought this patent was bad for ambiguity. There seemed to be some danger of the well-known rule of law against ambiguity being in practice invaded. It was the duty of a patentee to state clearly and distinctly, either in direct words or by clear and distinct reference, the nature and limits of what he claimed. If he used language which, when fairly read, was avoidably obscure or ambiguous, the patent was invalid, whether the defect was due to design or to carelessness or want of skill. Where the invention was difficult to explain, due allowance would, of course, be made for any resulting difficulty in the language. But nothing could excuse the use of ambiguous language when simple language could easily be employed, and the only safe way was for the patentee to do his best to be clear and intelligible. To his mind, this was a very plain case of offence against the rule. He could not see what purpose there could have been for using the roundabout language here employed. He thought that the appeal should be dismissed with costs."

The legislation of recent years has made it possible, however, for the patentee to abandon a claim which is bad, for any reason, without invalidating the patent. Such legislation affords encouragement to the cult of the obscure, and provides a large field for those who are engaged in the framing of specifications, and for those others whose business it is to exploit patents, and sometimes to embarrass industry.

No student of this subject can afford to deny himself the advantage of studying the historic cases of Boulton and Watt *v.* Hornblower and Maberly, and Boulton and Watt *v.* Bull. Both were actions for infringement heard before Lord Chief Justice Eyre, the first mentioned being taken on December 16th, 1796, at Guildhall, London. Watt's original patent (No. 913) was granted on January 5th, 1769, and subsequently extended by Act of Parliament. The defendants relied to a great extent on lack of definition in Watt's specification. Particular play was made of the use by Watt of the word "principles," and learned expert witnesses contended—with much plausibility—that Watt took his patent "not for what he had invented, but for what he might invent in future." Special forensic havoc was wrought by the redoubtable Joseph Bramah in respect of the fifth clause in Watt's specification, which he pleasantly described as "a complete fumble of incoherent, unconnected, absurd, and indigested ideas; so blended and coagulated with mystery, ambiguity, and impossibility in practice, that it is a disgrace to the writer, and would undoubtedly ruin any mechanic who might attempt to analyse it." Bramah's arguments in this famous case are well worth studying, and while he protested too much, in some points he had undoubtedly the best of the argument.

Lord Chief Justice Eyre subsequently agreed that the word "engine" implied "something composed of parts; and consequently these parts must have proportion and relation one to another; which he [Bramah] properly calls organisation; so that the word 'engine' does certainly comprehend and impress the mind with an idea of some organised machine, and not principles only." The judge, while he allowed a verdict in the plaintiffs' favour, remarked, relatively to their action, that "how far they had a right to prosecute for the infringement of their engine when in their petition to the King [George III] they had claimed none, nor even in their specification properly described one, I must leave the Court to determine at a future time."

The litigation over Watt's patent has the added historical interest of being doubtless the first occasion on which the question of principle in an invention cropped up.

Among notable judgments in patent actions of more recent date is one pronounced by Mr. Justice Neville in an action brought against an automobile building company for alleged infringement of a patent relating to internal combustion engines. The defendants denied infringement, and set up the usual defences of want of novelty and anticipation. His lordship held that there had been no infringement. An engine made in conformity with the plaintiffs' specification would not work at all. The mistake was that the piston had been placed on the wrong side of the engine in the specification. The plaintiff contended that this mistake would be obvious to any engineer, and he would see how it could be corrected, but, on the evidence of the defendants, his lordship was satisfied that the specification, as it stood, presented to the inquirer a mechanical problem of considerable difficulty, and the solution, which was said to be obvious, did not occur to any of the witnesses who were set to solve the problem.

In his lordship's opinion, "the action was a somewhat audacious attempt to resuscitate a patent from an invention of a very small compass, and by amendment make it cover and embarrass a very large field of industry. So far as he was concerned, that attempt failed, and he dismissed the action with costs."

There is an increasing tendency towards the framing of claims, not in terms of the actual device which the inventor has thought out, but in terms of the object effected. This is the type known as a "mean's claim," and it can be illustrated by taking an example wherein a door is described not as a door, but as a means of access to an enclosed space. Such a claim would easily be disposed of, since it might cover a door, a trap door, a window, a skylight, or any other device used for closing an aperture.

A list of inventions which, of incalculable industrial value, have never been patented would include some of the most familiar devices known to engineers. Among them may be mentioned the Stephenson link motion, first proposed almost a century ago by William Howe, engineer assistant to George Stephenson at the works of the Clay Cross Company, Chesterfield. Another device still earlier and even more familiar is the expanding chuck, invented by Lewis Gompertz, but never patented. Other inventions which, duly patented, have lapsed through non-payment of fees include some of the most important inventive steps made during the past century. They include the four-stroke cycle of Alphonse Beau de Rochas and the pilot injection of Herbert Akroyd Stuart.

It was pointed out recently by an American writer (Arthur Connolly) that countless applications resulting from laboratory research are whittled away by patent agents and examiners who rely solely on library research. This library research may call for only a few hours' work, whereas the laboratory research may be long, protracted and expansive. Nevertheless, the examiner is quickly able "to obtain sufficient proof to satisfy a highly interested scientist that a large portion of a carefully executed laboratory research programme was merely duplication. He did not rely on information not available to the public. All proof of unpatentability was from publications available to anyone taking time to find and read them. Thus we see a research programme practically nullified because the laboratory phase was emphasised and the library phase pretty well ignored. The romance of discovering secrets of nature in the laboratory was preferred to the drudgery of reading and digesting dusty patents, pamphlets, and other scientific publications. Mr. Connolly mentions that the annual reports of the Secretary of Commerce (U.S.A.) over a period of years indicate that about 30 per cent. (more than 15,000 each year) of the patent applications filed are abandoned. The predominant reason for abandonment is that the subject-matter disclosed in the application has already been described in published literature.

There can be no doubt that manufacturers lose much by not giving substantial monetary recognition to employees who originate useful improvements, which may be the subject of letters patent. Such patents have frequently become the absolute property of the employer, though the name of the inventor-employee may be entered in the patent specification. Very different was the procedure of the Eastman Kodak Company, Rochester, N.Y., in dealing during the summer of 1914 with Henry J. Gaisman, who discovered how to sign and date a film at the time the picture is taken. He is reported to have said that he would have taken 10,000 dollars for his work and have "jumped at" 50,000 dollars. The company paid him 300,000 dollars. In arriving at this total, the late Mr. George Eastman fixed an adequate salary for the four years during which the inventor had worked on his device, and that amount was doubled. Then the cost of the laboratory was agreed upon and the amount doubled. To this total enough was added to make 300,000 dollars, a sum assessed not on the basis of what the device cost the inventor, but on its value in expected profits to the company.

One of the best things ever said about invention is contained in a discourse delivered by Sir Joshua Reynolds—using words possibly supplied by his friend Dr. Johnson—before the Royal Academy more than a hundred and sixty years ago: "Invention is one of the great marks of genius; but if we consult experience, we shall find that it is by being conversant with the inventions of others that we learn to invent, as by reading the thoughts of others we learn to think."

BOOKS RECEIVED

Sewage Treatment Works. By C. E. Keefet. London: McGraw-Hill Publishing Company, Ltd., Aldwych House, W.C.2. Price 42s.

Pressworking of Metals. By C. W. Hinman. London: McGraw-Hill Publishing Company, Ltd., Aldwych House, W.C.2. Price 28s.

Steam Turbine Principles and Practice. By T. Croft. London: McGraw-Hill Publishing Company, Ltd., Aldwych House, W.C.2. Price 21s.

The Practical Application of Aluminium Bronze. By C. H. Meigh. London: McGraw-Hill Publishing Company, Ltd., Aldwych House, W.C.2. Price 17s. 6d.

Relaxation Methods in Engineering Science. By R. Southwell. London: Oxford University Press, Amen House, Warwick Square, E.C.4. Price 17s. 6d. net.

Aircraft of the Fighting Powers. Compiled by H. J. Cooper and O. G. Thetford. Leicester: The Harborough Publishing Company, Ltd., Allen House, Newarke Street. Price 10s. 6d.

The Design of Condensing Plant and Cooling Water Systems*

By W. T. BOTTOMLEY, A.R.T.C., Assoc. Member

(*Continued from page 406, June 20th*)

SECTION II

THE DESIGN OF THE CONDENSER

THE following formula is adopted as a basis for condenser calculation :—

$$\theta_m = \frac{W\,R}{S} \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

where θ_m = the logarithmic mean temperature difference from the steam on outside of the tubes to the water inside in degrees Fahrenheit.

W = Total heat transmitted per hour in 1000 B.Th.U.

R = Overall thermal resistance multiplied by $1000 = \frac{1000}{K}$.

S = Total internal surface of the tubes across which the heat is transmitted, in square feet.

K = Coefficient of heat transfer in B.Th.U. per hour per square foot per degree Fahrenheit temperature difference.

Throughout this paper the reference to the condenser surface denotes the internal surface of the tubes to avoid corrections, because the effect of the velocity of the water through the tubes on the friction loss and on the thermal resistance is proportional to the internal surface and not the external surface.

The load on the condenser or the heat transmitted per hour W is given in units of 1000 B.Th.U. W represents the equivalent pounds of steam entering the condenser per hour, assuming the latent heat is 1000. The author prefers the old-fashioned method of specifying the load because it shows at a glance the heat units per hour. Actually, the latent heat in the steam is less than 1000, so that W is rather less than the actual steam entering the condenser. In modern practice the maximum wetness fraction at the exhaust is limited to 12 or 13 per cent., in which case the minimum latent heat entering the condenser is limited to about 920 B.Th.U. per lb. Except for fixing the dimensions of the steam passage at the entrance to the condenser, it is unnecessary to know the exact quantity of steam entering the condenser or the latent heat, but only the product of the two, *i.e.*, the total heat, and this is satisfactorily defined by the symbol W given above.

METHOD OF DETERMINING THE LOAD ON THE CONDENSER

With progressive feed heating measurement of the condensate leaving the condenser does not as a rule give the quantity of steam entering the condenser because it includes the drains from the feed heaters.[11] The load on the condenser should be determined both on test and in actual operation by the method given in Standard Test Code, issued by the B.S.I. (see 1940 edition, No. 752). The load is determined by deducting from the overall consumption of the turbine the energy delivered to the shaft in heat units. The difference represents the heat extracted by the condenser. The energy delivered to the shaft is

$$\frac{\text{H.P.} \times 2540}{\text{Mechanical efficiency}} \text{ B.Th.U. per hour.}$$

The mechanical efficiency for turbines over 10,000 H.P., say, is 98 to 99 per cent. Where the turbine is driving an alternator, the heat energy delivered to the shaft is

$$\frac{\text{kW} \times 3412}{\text{Mechanical efficiency} \times \text{alternator efficiency}} \text{ B.Th.U.}$$

per hour the alternator efficiency being of the order of 97 per cent. This method is applicable to both progressive feed heating and reheating cycles, as well as to straight non-reheating and non-feed-heating cycles.

The load for which the condenser should be designed should be the expected average annual load during the hours when the turbine is running. This should be the load corresponding to the rated economical load on the turbine, but generally it is about 90 per cent. of the economical rating.

THE OVERALL THERMAL RESISTANCE

The overall thermal resistance is the sum of the resistances of the various parts of the passage of heat from the steam outside the tubes to the water inside. These are :—The resistance of the film between the steam and the outside surface of the tubes, the resistance to conduction through the metal of the tube, the resistance to conduction through the deposit on the inside surface of the tube, and the resistance of the water film inside the tube. The condenser should be designed for the average annual thermal resistance anticipated in practice, and not for test conditions.

The thermal resistance of the water film inside the tubes is dependent on the water velocity. The rest of the overall thermal resistance is independent of the water velocity. To determine the economical velocity of the water through the tubes, it is desirable that the effect of water velocity on the thermal resistance should be expressed with a certain degree of accuracy.

Data for this have been determined experimentally by Eagle and Ferguson and given in their paper in 1930,[12] where it is shown that for a given temperature $R'v = f(v\,d)$, where R′ is the thermal resistance from tube to the water. Fig. 5 in their paper shows $10\,R'v$ plotted as a function of $v\,d$ when the water temperature is 60 deg. Fah., and Table IV in the same paper gives particulars for determining the relation for other temperatures. The range of $v\,d$ for condenser design is from 2 to 7, assuming that only ¾in. and 1in. O.D. tubes are considered, and that the range of velocities is from 3ft. to 8ft. per second, and within this range, $R'v$ at a given water temperature can be represented in terms of $v\,d$ by a straight line without causing a greater error in the resultant vacuum temperature than 0·05 deg. Fah. under economical conditions of loading. The results of Eagle and Ferguson's experiments are shown in Fig. 8 for different water temperatures where $R'v$ is plotted against $v\,d$. By drawing average straight lines for each temperature, the expression for R′ is

$$R' = R_1/v + R_2 d \quad . \quad . \quad . \quad . \quad (7)$$

where R_1 and R_2 are constants, depending on the temperature. The values of these constants are given in the following table :—

Temperature, deg. Fah.	R_1.	R_2.
40	4·67	0·2
60	3·88	0·183
80	3·34	0·168
100	3·0	0·15

The accuracy of this straight-line method of expressing $R'v$ may be judged from the fact that if the loading on the condenser is 5 lb. per square foot and the water velocity is 5ft. per second, an error of unity in $R'v$, *i.e.*, from 3·5 to 4·5, represents an error in the vacuum temperature of 1 deg. Fah. It will be seen from Fig. 8 that the discrepancy due to the approximate method is very small. The overall thermal resistance of the condenser is therefore given by

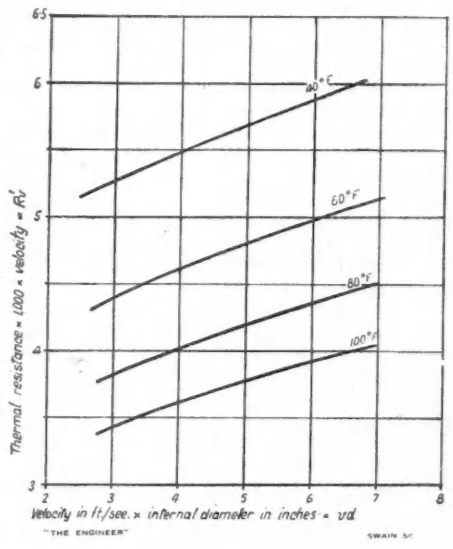

FIG. 8—*Thermal Resistance from Tube to Water from Data given in Eagle and Ferguson's Paper*

$$R = R_1/v + R_o \quad . \quad . \quad . \quad . \quad . \quad (8)$$

The value of the part of the overall thermal resistance which is independent of the velocity R_o will be judged from test results for clean condensers and from operating results for average operating condition of dirtiness ; but before fixing values for these it is necessary to define the logarithmic mean temperature difference in Eq. (6) and to determine the expression for it in such a form as to enable the differentials in Eq. (3) to be determined.

LOGARITHMIC MEAN TEMPERATURE DIFFERENCE

The author prefers to use distinctive symbols for temperature differences. These are :—

x = Temperature rise of water through the condenser.

y = Vacuum temperature fall through the condenser due to pressure drop.

A = Difference between initial vacuum temperature and circulating water inlet temperature.

B = Difference between initial vacuum temperature and the circulating water outlet temperature.

Therefore

$$A = B + x \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

The final temperature difference = B and the initial temperature difference is $(A - y)$. Owing to the high thermal resistance of the air cooler portion of the condenser, if there is any air or gas present in the steam, no simple formula for the mean temperature difference can be devised to include the air cooler with any pretence of accuracy. We therefore adopt a conventional expression for the mean temperature difference and adjust the expression for the overall thermal resistance to fit the data available. In a good modern condenser the vacuum temperature drop y is small. In some cases it is a rise due to the recovery of velocity head. It is therefore proposed to use the simple Grashof formula for the logarithmic mean temperature difference based on the two temperature differences A and B, *i.e.*,

$$\theta_m = \frac{A - B}{\log_e A/B} = \frac{x}{\log_e A/B} \quad . \quad . \quad . \quad . \quad (10)$$

The form of this equation with the logarithmic term is unsuitable for determining in conjunction with Eq. (6) the differentials of T in Eq. (3A) and (3B), but a way out of the difficulty will be found if θ_m/x is plotted against B/x, as shown in Fig. 9. In the same figure is plotted also the straight line obtained if θ_m is assumed to be the arithmetical mean, the formula being

$$\theta_m/x = \tfrac{1}{2} + B/x \quad . \quad . \quad . \quad . \quad (11)$$

The extreme range of B/x for condenser operation is from 0·4 to 1·5 and the logarithmic curve within this range can be very accurately given by a straight line, the formula being

$$\left.\begin{aligned} &\frac{\theta_m}{x} = a + m\,B/x \\ &\text{where} \\ &\qquad a = 0{\cdot}4 \text{ and } m = 1{\cdot}04\,; \\ &\text{therefore} \\ &\qquad \theta_m = a\,x + m\,B \\ &\qquad\quad = m\,A - (m-a)\,x \end{aligned}\right\} \quad (12)$$

Substituting the value of θ_m given in Eq. (6) and putting $A = T - t$ and $x = W/0{\cdot}6\,G$, the following relation is obtained for the vacuum temperature :—

$$\left.\begin{aligned} &T = \frac{W}{S}\frac{R}{m} + \left(\frac{m-a}{m}\right)\frac{W}{0{\cdot}6\,G} + t \\ &\text{or} \\ &T = \frac{W}{S}\frac{R}{m} + 0{\cdot}615\,x + t \end{aligned}\right\} \quad (13)$$

The average annual value of t, which is the circulating water inlet temperature, is fixed for a given locality when river water is used, but for cooling towers t depends on the size of the towers, the effect of which will be considered later.

From Eq. (13) the following differentials for Eq. (3) are obtained :—

$$\delta T/\delta S = -\frac{R}{m} \cdot W/S^2 \quad . \quad . \quad . \quad . \quad (14)$$

$$\delta T/\delta G = -\left(\frac{m-a}{m}\right)\frac{W}{0{\cdot}6\,G^2} \quad . \quad . \quad (15)$$

The first differential is independent of the quantity of water and the second is independent of the condenser surface. It is assumed for the first differential that R is independent of the quantity of water and the surface. R depends on the velocity through the tubes, and as it will be shown later, the economical velocity is independent of the surface and the quantity of water.

Eq. (13) has been found to be reliable and accurate within the range stated. It can always be checked by means of Eqs. (6) and (10). Several deductions can be made from it. For example, for constant water velocity the effect on the vacuum temperature of increasing or reducing the surface is independent of the quantity of circulating water, and the effect of altering the quantity of water at constant velocity on the vacuum temperature is independent of the surface area. Again, at consta t velocity the increase in the vacuum temperature due to an increase $d\,x$ is 61·5 per cent. $d\,x$.

THE EFFECT ON THE FINAL TEMPERATURE DIFFERENCE OF VARIATIONS IN THE VALUE OF R_o DUE TO DIRT IN THE TUBES OR DUE TO AIR BLANKETING ON THE STEAM SIDE

Eq. (13) also enables the effect of variations in the value of R_o in Eq. (8) to be determined for a given condenser in operation. The variation in the value of R_o in practice is due to the effect of dirt in the tubes, but it can be due to the effect of air blanketing, and also due to pressure drop on the steam side of the condenser.

For a given condenser in operation, since the velocity of the water through the tubes is proportional to the quantity of water flowing, Eq. (13) shows that the final temperature difference B does not vary more than a fraction of a degree for large variations in the quantity of water, assuming constant load. For since

$$T - t = A = B + x = B + W/0{\cdot}6\,G,$$

then by Eq. (13),

$$B = \frac{W}{S}\frac{R}{m} - \frac{a}{m}\frac{W}{0{\cdot}69} \quad . \quad . \quad . \quad . \quad . \quad (16)$$

The velocity of the water through the tubes is

* North-East Coast Institution of Engineers and Shipbuilders, March 28th, 1941.

[11] In spite of this, the B.E.A.M.A. still insert a clause in condenser specifications whereby the quantity of c.w. is determined from the temperature rise by measuring the condensate and assuming the latent heat is 950.

[12] I. Mech. E., 1930, Vol. II.

given by Eq. (5). Eliminating G by Eq. (5) and (16), and putting R in terms of R_1 and R_o and the velocity by means of Eq. (8), then

$$B=\frac{W}{S}\frac{R_o}{m}-\frac{1}{v}\frac{W}{S}\frac{m}{}\left\{\frac{a\,p\,l/d}{4\cdot68}-R_1\right\} \quad . \quad . \quad (17)$$

If the value of $p\,l/d$ is about 45, then the velocity term in Eq. (17) is nil. Therefore

$$B=\frac{W}{S}\frac{R_o}{m}. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (18)$$

If $p\,l/d$ is greater or less than 45, the correction for the velocity term in Eq. (17) will be a fraction of a degree on the value of B, and the effect of changes in the water quantity and velocity can be neglected.

To show the value of R_o obtained in practice, Table I gives twelve average monthly readings taken from the routine log sheets at Dunston "B" power station, from which the average value of R_o is determined for each month and the average obtained for the year ended June, 1940. There are four machines and the condenser of one of the machines is gun-cleaned every week-end if possible. The average value of R_o for the year is 2·3. From evidence obtained elsewhere, this value for R_o appears to be normal.

TABLE I.—*Average Monthly Performance of the Condensing Plants of Dunston "B" Power Station, Showing the Average Annual Value of R_o in Eq. (8)*

	Water temperatures.			Vac. temp.—C.W.		Plant load factor.*	R_o in Eq. (8).
	Inlet.	Outlet.	Rise.	Inlet.	Outlet.		
1939.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Per cent.	
July	62·4	75·0	12·6	21·0	8·4	67·34	1·75
August	63·6	77·2	13·6	25·5	11·9	63·12	2·56
September	61·9	73·5	11·6	22·6	11·0	56·51	2·58
October	52·0	66·0	14·0	23·7	9·7	64·21	2·07
November	47·0	63·0	16·0	25·7	9·7	65·26	1·99
December	45·0	59·2	14·2	26·8	12·16	67·41	2·25
1940.							
January	41·0	57·0	16·0	33·0	17·0	74·45	2·94
February	40·0	57·0	17·0	32·7	15·7	77·45	2·76
March	42·8	60·2	17·4	32·1	14·7	75·42	2·57
April	48·0	64·0	16·0	26·9	10·9	83·44	1·79
May	54·8	72·04	17·24	32·9	15·3	86·64	2·32
June	65·0	80·6	15·6	27·4	11·8	79·27	2·04
						Mean	2·3

* Plant load factor = $\frac{\text{Units generated}}{\text{C.M.R. load} \times \text{machine-hours run}}$

During the official test after gun cleaning on one of the condensers, at Dunston, the final temperature difference B obtained was 8·3 deg. Fah. at 100 per cent. load, making $R_o = 1·30$. The increase in the value of R_o under average operating conditions above gun-cleaning conditions is therefore 1·0. During the official test on another of the condensers after being wire brushed, the final temperature difference obtained was 4·5 deg. Fah. at 80 per cent. load, and R_o was 1·00. The increase in the value of R_o under average operating conditions above wire-brushed conditions is therefore 1·3.

in Eagle and Ferguson's Paper.

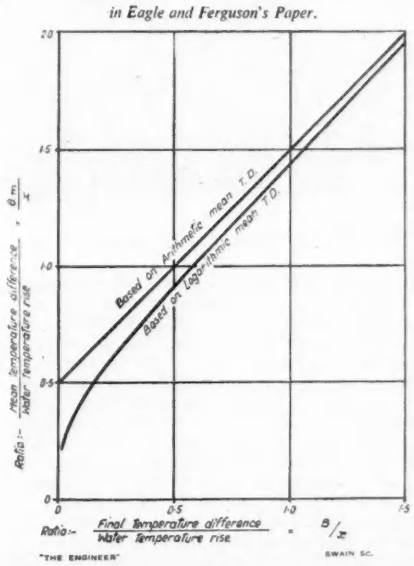

FIG. 9—*Condenser. Relation between Temperature Ratios*

POWER EXPENDED IN PUMPING THE CIRCULATING WATER THROUGH THE CONDENSER

The power expended in pumping the circulating water through the condenser depends on the quantity of water and the resistance head. The head depends on the cube of the velocity and the ratio of the quantity of water to the surface area of the condenser.

$$\text{The resistance head} = \frac{v^2}{15}\frac{S}{G} \text{ feet} \quad . \quad . \quad (19)$$

$$\text{and the power in kW} = \left(\frac{v}{36}\right)^3 S \quad . \quad . \quad (20)$$

The resistance head depends on the state of dirtiness of the condenser and for economic consideration, apart from test conditions, the resistance under average annual state of dirtiness should be taken to determine the average annual pumping loss. Particulars given in Table VI of Guy and Winstanley's paper indicate that the value of the constant when wire-brushed is about 18, and just before cleaning value is reduced to 12. For average conditions the value is assumed to be 15, and the corresponding value of the constant in Eq. (20) is assumed to be 36.

From Eq. (20) the following differential for Eq. (3A) is obtained, assuming the velocity is constant :—

$$\frac{\delta}{\delta}\frac{P}{S}=\left(\frac{v}{36}\right)^3 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (21)$$

ECONOMICAL WATER VELOCITY IN THE CONDENSER TUBES

The economical surface in Eq. (4A) is given in terms of a fixed water velocity, because the value of R depends on the water velocity and a velocity term appears in Z's. The economical velocity is determined by differentiating the product $Z's\,R^{13}$ with respect to the velocity and equating to zero, and the economical velocity is given by the solution of the following equation :—

$$\left(\frac{v}{36}\right)^3\left[\frac{3\,R_o v}{R_1}+2\right]=Z_S/Z_P \quad . \quad . \quad (22)$$

The result is shown in Fig. 1. The ratio of Z_P/Z_S is of the order of 55 and the corresponding economical velocity is low, *i.e.*, about 4·3ft. per second.

(To be continued)

Present-Day Power Trends*

By A. G. CHRISTIE†

TO-DAY'S trends in power development are influenced by recent economic and political events. The depression which started in 1929 led to large reductions in the power loads of utilities and industries. As a result ample reserve capacity was available for several years and few new generating units were installed. But the domestic load continued to increase throughout this period. The Government undertook large-scale hydro-electric developments in various parts of the country with the stated intention of lowering rates for electrical service. The Government also started a campaign for rural electrification. While many engineers disagree with the methods by which the selling prices of the various services have been fixed by the Government's agencies, these developments have been contributing factors in the present trends.

In 1937 a noticeable improvement in business made it apparent that an early pick-up in industry would require additional generating capacity. This has proved a fortunate circumstance, for the equipment ordered at that time is now available. The start of the war in 1939 and the rapid rise in industry since then have greatly increased the demands for power. One large utility recently stated that its output in kilowatt hours doubled in the last six years. Fortunately, new hydro-electric capacity now available, together with the reserves of the public utilities, have been sufficient to meet all demands to date with a reasonable stand-by. In the meantime, additional equipment aggregating a large kilowatt capacity has been ordered or is being installed, and this will add to available power as demands increase. Barring untimely strikes, sabotage or dislocation of labour in plants building power plant equipment, the electric utilities appear able to meet all demands due to the defence emergency.

HYDRO-ELECTRIC POWER DEVELOPMENT

The attention of the public has, for some time past, been centred on hydro-electric developments. Some notable plants have been completed by the Government in the last decade, such as Boulder dam, the T.V.A. plants, and Bonneville, while work is actively progressing at Shasta and Grand Coulee. The Canadian plants at Niagara Falls have been permitted to use additional water during the present emergency and in anticipation of the diversion of water into Lake Superior from the Hudson's Bay watershed. Additional capacity has been added at Beauharnois on the St. Lawrence River and at La Tuque on the St. Maurice River.

Hydro-electric plants serve two classes of customers: the large power user located close at hand as at Niagara, Shawinigan, Alcoa, Arvida, &c., or public utility loads at varying distances from the plant. Boulder dam is among the latter, with transmission lines 267 miles long to Los Angeles. Others have loads closer at hand. The American consumer demands continuity of service and consequently steam stand-by plants are already provided or will soon be needed by the vast hydro-electric systems of the United States. For instance, new steam stations are now under design for the T.V.A. system and at Los Angeles for Boulder dam. Other large hydro-electric systems may add steam stand-by plants, in some cases to care for low water flows, in others to avoid interruptions to service.

From a military point of view hydro-electric plants are vulnerable while long-distance transmission lines are subject to interruptions. These considerations further emphasise the necessity of steam stand-by service in the communities served. Also transmission lines should be located so that these can be easily patrolled in case of war.

The latest available figures for this country indicate that 26 per cent. of the kilowatt-hours output of the public utilities came from hydro plants though the installed capacity was 28 per cent. of the total of hydro and steam capacity in all public utility power plants.

What about further hydro-electric developments? Canada possesses many large undeveloped sites ranging from Labrador to the Pacific Coast which can be developed as needs arise in the future. By means of remedial works in the rapids above Niagara Falls additional water can be diverted for power development on both sides at a central point where it can be of maximum value. Additional sites are available on the Colorado River above Boulder dam. Other developments are possible in many other parts of the country.

The development of the International Section of the St. Lawrence River has been retarded by political considerations concerned with the proposed deep waterways through the Great Lakes. There is much confusion regarding the cost of this large project. In 1925 the Hydro-electric Commission of Ontario published a report of their studies of this development. One proposal was for a single dam to give 75ft. head, which would permit the development of 1,113,000 kW at a total cost of 141,700,000 dollars, or 127 dollars per kilowatt. Provision for deep waterway navigation would cost 68,150,000 dollars additional. With 75 per cent. load factor the Commission estimated that this power could be delivered at the end of a transmission line 300 miles long and stepped down to 12,000 volts at a cost between one-half and two-thirds cents. This project awaits international agreement before development is undertaken.

One can safely predict that additional hydro-electric capacity will be developed as rapidly as political and economic considerations warrant.

STEAM GENERATED POWER

Some lucid writer in the future will unfold the fascinating romance of steam power development. At the beginning of the century steam engines drove electric generators when supplied with steam at pressures seldom above 140 lb. per square inch. This steam was generated in many small-capacity boilers, often with hand-fired furnaces served by strong-backed, sweating firemen and equally sturdy ash handlers. Steam turbines have replaced steam engines. Unit capacities have increased beyond the conception of engineers of forty years ago. A keen, intelligent operator interprets his gauges and recorders and controls by the manipulation of a few push buttons the output and efficiency of large high-pressure high-temperature steam generators fired by powdered coal. Truly this is a revolutionary change!

Great central stations have been built and others will be planned. But one must consider factors which may influence their size. Difficulties arise where too many large feeders must radiate from a single plant. A large station makes an excellent target for aircraft attack. A number of smaller stations feeding into various portions of the distribution system would make the system less liable to complete outage. The large station emits enormous volumes of flue gases into the surrounding atmosphere, the dispersion of which raises problems. A number of smaller stations emitting the same total gas volume at widely scattered points would lead to more satisfactory dissipation. Finally, the practice of unit construction of one boiler one turbine permits the design of smaller plants with efficiencies practically equal to the super-power plant. A trend towards more scattered stations of moderate size may be considered a future possibility.

There is a distinct tendency towards the employ-

[13] Because the economical cost indicated by Eq. (4A) for a given velocity is $2\sqrt{Z'_s Z_T W \frac{R}{m}}$.

* Address to the Mid-West Power Conference, Chicago, April, 1941.

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ment of high pressures and high temperatures in new plants. Many will operate at 850 lb. per square inch and 900 deg. Fah. at the throttle, while an increasing proportion of new units will employ 1250 lb. per square inch and temperatures up to 950 deg. Fah. Superposed units in general are built for the higher pressures and temperatures. Temperatures in these ranges are closely controlled by desuperheaters, by pass dampers, &c. Advances to still higher pressures appear to depend on the production by our metallurgists of metals capable of standing even higher temperatures. There is considerable basis for the expectation that such metals suitable for 1200 deg. Fah. may soon be at hand, in which case initial pressures of 2000 lb. to 2500 lb. per square inch may be employed on the regenerative cycle without excessive moisture at the exhaust.

This advance in pressure will not be made without some extensive changes in plant equipment. The increased density of the saturated steam may necessitate the more rapid development of forced circulation boilers. Already one such boiler for 2000 lb. per square inch, 960 deg. Fah., with reheater is under construction. The problems arising from circulation in boilers are receiving much attention and boilers are being modified to secure more positive flows in steam generating tubes.

A marked trend in recent years is towards the employment of bent tube steam generators with definite circulation paths from and to the drums. These appear to have overcome the recirculation difficulties experienced in certain earlier straight-tube types.

The tremendous influence on boiler design of radiant heat as a means of effective heat transfer is now recognised in the design of practically all boilers. This means of heat transfer has not been fully exploited, even though one manufacturer is now offering a "radiant type." Some future design may provide still higher furnaces than at present or use two-stage furnaces, both of which will be designed almost wholly for radiant heat transfer to the steam generating tubes forming the solid furnace walls.

While stokers continue to be added in the older stations and where special fuels are used, practically all new coal-fired plants burn pulverised coal. Furnaces with powdered coal may have wet or dry bottoms, depending upon the fusibility of the ash and the nature of the load. Low fusing ashes, such as are found in Mid-Western coals, and high continuous loads favour the wet bottom. Eastern high-fusing ash and loads requiring frequent shut-downs, as on stand-by or peak load service, lead to the use of dry-bottom furnaces. Due to low grindability of Western and Northern lignites the spreader type stoker may be employed for their combustion.

The nature of the ash in available fuels has a great influence on steam generator design. The fusible ash particles formed during combustion must be cooled and solidified before coming in contact with boiler or superheater surfaces or the deposits on such tubes will plug up gas passages and require hand labour for lancing while in service. To avoid such deposits, furnaces may be made larger with lower average rates of heat release to ensure proper gas temperature at exit and tubes of both boiler and superheater may be spaced wider apart, even at the expense of greater total superheater tube surface.

It will be evident from the preceding paragraphs that steam generator designs are still being modified. No standardisation is in sight and further changes are forthcoming.

A most important consideration in operation is the assurance of clean steam. Methods of centrifuging and washing the outgoing steam have been tried and notable advances have been made. Studies of boiler water conditioning to avoid scale and corrosion have led to marked improvements in operation. Much still remains to be learned about the action of water in high-pressure boilers. Silica in feed water has been difficult to remove. Our chemists will eventually develop satisfactory boiler water.

Steam generators have been built for outputs up to 1,000,000 lb. per hour. There appears to be no obstacle to the construction of larger boilers with welded parts. Troubles with rolled joints at high pressures may lead to the welding of all boiler tubes. Long water wall tubes and most of the piping connected to the steam generator are now welded. Steam lines to turbines are now generally welded throughout.

The trend in steam turbine development is towards the use of units operating at 3600 r.p.m. They are of less weight and, with smaller physical dimensions, are less affected by temperature changes than 1800 r.p.m. units. These condensing units are more economical than 1800 r.p.m. turbines in sizes below 50,000 kW. There is little thermal advantage in the 3600 r.p.m. units in condensing turbines above 50,000 kW capacity, but larger units have been purchased for other reasons. Earlier difficulties with high-pressure blading appear to be overcome.

Generators above 25,000 kW are now generally cooled with hydrogen. Large two-pole generators at 3600 r.p.m. are subject to 120-cycle vibration. This has been overcome by mounting the stator core on supporting devices, which prevent the vibration being carried to the foundation.

Rearrangements of the tube lay-out have improved condenser performance and still further changes can be made. Tubes rolled at both ends with some flexible member to care for differential expansion are now generally employed. More attention will be given to tube materials and to tube supports which prevent vibration, in order to secure longer life and lower maintenance charges.

It is becoming general practice in coal-burning plants to install some form of dust catcher in the flue gas ducts. Cottrell precipitators, cyclones and washers are in use for this purpose. Clean flue gases will be required from most new plants in the future.

The operation of large high-pressure steam generators, turbines and their auxiliaries requires intelligent and highly trained operators. Large utility systems are justified in having expert chemists, metallurgists, maintenance men and designers on their operating staff, in addition to the mechanical and electrical engineers in charge of the plants. In brief, utility operation is becoming an attractive career for young technical men.

Improved operating efficiency and increased heat drop have decreased the B.Th.U. per kWh, which results in decreased coal consumption. However, increased coal prices may offset this reduction in cost. As a result, production costs may change only slightly.

The mercury-steam stations now in service continue to operate satisfactorily and improvements have been made in the design of the mercury boilers. The additional cost of this equipment and the narrowing margin of gain in thermal performance over high-pressure steam plants tend to restrict the increasing use of this efficient system.

Internal Combustion Engines

Many diesel engines have been built during the past few years. The vast majority of these have been used in automotive equipment, such as tractors, railway locomotives, trucks and contractors' equipment, and in marine installations. A considerable number have been installed in industrial plants. While many have been built for public utility service in municipal and other plants, the aggregate output in kilowatts is only a small fraction of the nation's generating capacity.

The diesel engines will continue to be used in small plants and for automotive service. They will probably never be a large factor in public utility service because they have not been built in large sizes and, if built, their economy would not differ greatly from that of large steam stations.

The gas turbine is attracting attention and several have been installed in oil refineries operating on the Houdry process. Its efficiency is dependent upon initial gas temperatures, which are now limited to about 1000 deg. Fah. Under such conditions it is not a competitor from a thermal standpoint with diesel engines or condensing turbines. However, when metals are available for higher temperatures and gas turbines are built in such sizes as to warrant the use of several heat recovery auxiliaries, it may find a place in sections where cheap oil and gas are available and particularly where water is scarce, as no condensing water is needed. It may also be used on locomotives.

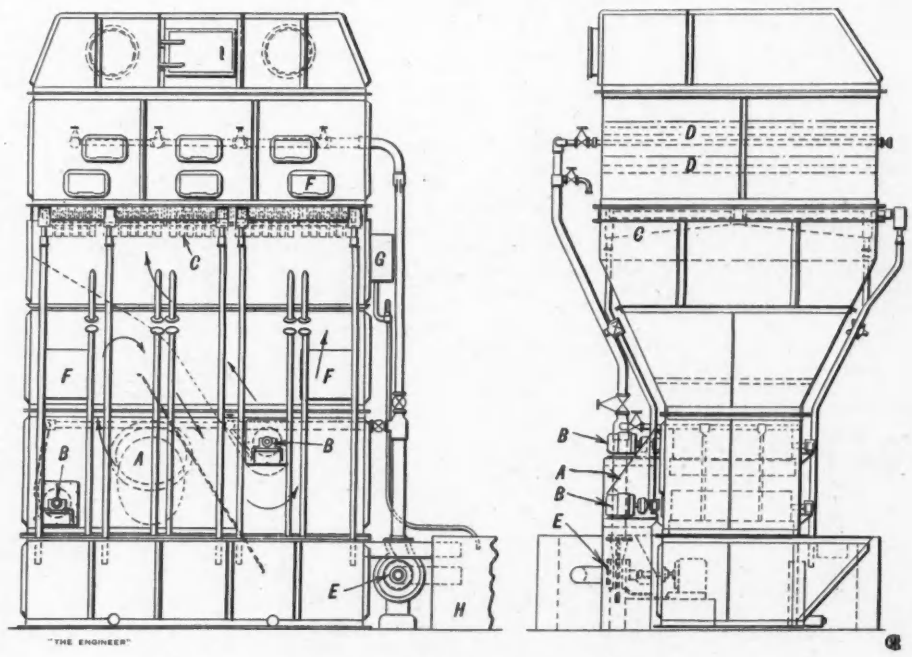
The Future

Predictions of future developments are dangerous, as they are usually wrong. However, the continued increase of output of our utilities indicates that loads have not ceased growing and that greater total plant capacities must be provided in future years. Larger and more economical steam generators and turbines will be utilised and improved forms of equipment provided. Power plant development in the future will require the best skill and equipment this country can offer, for progress must not cease.

Purification of Air and Gases

We are informed by Controlled Heat and Air, Ltd., of Birmingham, that the firm has recently taken up the manufacture of plant for the purification of air and gases. It is the sole licensee and manufacturer in the British Isles of Traughber filters. Traughber filters are not new. Indeed, plants are now in operation all over the world. A typical modern installation is shown in an accompanying half-tone engraving. Improvements have, however, been made from time to time and a description of a modern plant may prove of interest.

The success of a wet filter largely depends upon the degree to which the particles in suspension in the air or gas can be wetted. It is important, therefore, that the largest possible surface liquid and the gas to be purified should come into intimate contact. Saturation of the air with moisture has an important effect, because the suspensions form nuclei upon which the moisture condenses, making them heavier. But many particles in suspension consist of materials which repel water. Furthermore, the smaller the particle, the greater is the amount of air or gas in which it is suspended, and adsorbed upon its surface. The quantity of gas thus adsorbed is also dependent upon the nature of the material, its electrical condition, the temperature and the pressure of the gas. Unless the liquid with which the particle is made to collide has a lower surface tension, relative to the particle, than the air or gas adsorbed, the particle will not be wetted. Even when a particle has been wetted the probability is that if the gas is not saturated, the moisture will evaporate off the surfaces of the particle before it has settled.



ARRANGEMENT OF TRAUGHBER FILTER

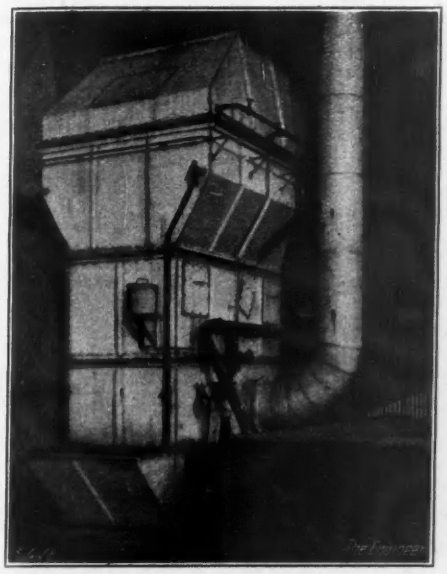
In the Traughber froth flotation filter some of the advantages of dry filters are combined with those of the wet type. The air or gas to be cleaned enters the filter at a velocity calculated to produce sudden expansion. The momentum of the larger particles precipitates them at once towards the bottom of the chamber. This sudden expansion slows up the velocity of the air and reduces its temperature. Thus hot gases can be treated, an advantage in that when hot they retain more moisture. The necessary intimate contact between large surfaces of gas and washing liquid is obtained by a simple yet effective method of atomisation of the liquid. A smooth-faced cylinder, rotating at a suitable speed in contact with the surface of a pool of liquid, picks up a film of this liquid and sprays it with considerable force in the form of a fine mist, sending it splashing, with the gas to be cleaned, against the sides of the filter. The momentum imparted to the droplets of liquid is relied upon to obtain the impact with both gas and liquid in intimate contact against the surfaces of the filter. The character of the mist, the density of the droplets, their size and the volume of mist, can be regulated by choosing the right diameter of cylinder and regulating its speed of rotation and the depth of immersion into the surface of the pool. On to this surface, from which the film of liquid is picked up, a minute quantity of a low surface tension liquid is allowed to drop at predetermined intervals. The result is that virtually every drop in the mist is covered

with an infinitestimal film of this low surface tension liquid, and very effective wetting action is obtained. In addition, the liquid acts as an evaporation retardant. As the spray and mist will reduce the temperature of the incoming gas, a reduction in its volume and consequently in its velocity is produced. Condensation upon the particles in suspension is accelerated. The low surface tension oil on the wetted particles insulates them electrically.

The Traughber filter has two mist chambers, so arranged that as the gas passes successively from one and through the other, becoming cooled down, the space occupied becomes larger so that progressive reduction in velocity results. As a result suspensions which, although wetted, are still too small to settle, function as nuclei for further condensations of moisture and they thus become heavier. The combination of slower speed and therefore greater difference of momentum between gas and suspensions helps the smallest particles to settle.

The final and characteristic stage of purification is achieved by bubbling the gases in fine streams through a layer of water—the froth floor—upon which the low surface tension oil forms a froth as the gases blow through. This froth, the thickness of which can be easily regulated by adjusting overflows, through which it carries all the rest of suspensions and impurities into the sump of the filter, is the equivalent of a filter cloth of constant, adjustable texture and resistance. Any froth entrained by the gas is arrested by low-resistance labyrinth rings, which are constantly flushed with water, while a second layer of such rings retains most of the moisture in the gases.

As will be seen from the accompanying diagram, the



MODERN TRAUGHBER FILTER

Traughber filter is simple in construction. The only moving parts inside the filter are the spray rotors. They have little resistance to overcome, as they only just touch the surface of the liquid, and the power required to operate them is only between 1 and 2 H.P. The fan and circulation pump are independent and outside the filter. The suspensions are collected in the form of a sludge, so that dust cannot be redispersed. The fan is usually placed behind the filter and operates in clean, cool air or gas.

The washing liquid used can, with suitable additions, be made to separate one gas from another, to neutralise acids, to bind or combine certain constituents, which can then be recovered. Thus Traughber filters can be made to eliminate SO_2 or H_2S gas from fumes and to condense carbon bisulphide, which can be distilled out of the washing liquid and used again. The washing liquid is clarified and recirculated so that the consumption of water can, when necessary, be reduced to that quantity which is evaporated in reducing the temperature of the ingoing gas to the temperature of the washing liquid.

Referring to the diagram, the air or gas receiver is shown at A. Its lower portion forms a reservoir for the washing liquid and the sump for the collected sludge. An overflow keeps the liquid level constant. The sludge may be discharged periodically or continuously by conveyor arrangement. The gases are deflected towards the surface of the washing liquid and project all the heavier particles of dust into the solution, leaving only the finer particles to be dealt with by the mist. The spray rotors B are plain steel cylinders carried on ball bearings and rotating at about 1200 r.p.m. The gases travel upwards through the mist and the wetting action of the special oil displaces the fine film of air surrounding the dust particles which are carried down into the reservoir. The froth floor above the air receiver contains a layer of washing liquid, also covered by a film of the special oil. As the air or gases enter they are deflected and carried below the surface of this liquid through serrated edges in finely divided streams. An adjustable overflow keeps the level of the froth constant and discharges into the washing reservoir below. Eliminators D retain any moisture which might be entrained with the moving air or gases. A circulating pump E supplies fresh washing liquid from the reservoir in the receiver in just sufficient quantity to float off the impurities captured by the oil froth. Inspection doors F, air-tight when closed, are provided in the lower as well as the upper chamber. An oil tank G with adjustable sight feed is located in a suitable position to feed the oil to the circulating system. The settling tank is shown at H.

The process can be used for treating hot or cold gases. It is claimed to give excellent results in the recovery of lead and zinc oxides from fumes, in the purification of producer gas, the elimination of dust from flue gases, the absorption of H_2S and SO_2, the recovery of CS_2, and the recovery of silver and other valuable dusts. Traughber filters are used in foundries for collecting sand blasting and polishing dusts, in potteries for the removal of soluble impurities in gases, for cleaning air for drying and enamelling purposes, and for disinfecting and humidifying air for air conditioning.

A Locomotive Fire Engine

FOR many years fire engineers have wondered why the potentialities of the steam locomotive should not have been made available for dealing with outbreaks of fire on railway property and areas contingent thereto.

About forty years ago a steam fire pump was kept at Southampton docks ready for attachment to shunting locomotives which carried special arrangements on the front buffer beam in order to allow of the fire pump being fixed to the engine whenever its services were required. The inevitable delays in getting the pump into operation militated against its success, and the machine fell into disuse for the purpose for which it was designed.

Towards the end of the last war the devastating fires that occurred in munition dumps in France

LOCOMOTIVE FIRE ENGINE

brought the subject again to light, and it was then decided that all the yard locomotives in the back areas should be fitted with proper fire-fighting equipment. The sudden collapse of the enemy, however, prevented this idea from materialising.

The whole subject has recently been revived by Mr. O. V. Bulleid, the chief mechanical engineer of the Southern Railway, who approached Merryweather and Sons, Ltd., of London and Greenwich, with regard to the supply of up-to-date steam fire pumps for fixing to tank locomotives available for the purpose.

The type of locomotive proposed was James Stroudley's "D.1—0–4–2" tank class, and it has been found possible to attach to these engines a powerful steam pump over the rear buffer beam. The engraving reproduced herewith gives a clear idea of the arrangement adopted.

The steam fire pump is of the Merryweather "Greenwich Gem" double-cylinder double-acting type, having a total delivery capacity of approximately 1 ton of water per minute at a pressure of 100–120 lb. per square inch and designed to throw four powerful jets immediately on starting up the pump.

The pump end is of gun-metal with copper air vessels on the suction and delivery branches. Rubber disc valves are fitted. Access to them is obtained by the removal of a single cover. A by-pass vave is also provided, enabling any quantity of water, from zero to the maximum output, to be delivered under normal speed conditions.

The steam supply is controlled by a master valve operated from the cab and a stop valve on the engine cylinders. The exhaust is taken to the atmosphere.

The question of a sufficient supply of water for the operation of the fire pump is, of course, an all-important one. A limited supply is always available from the feed tanks of the locomotive, which may be found useful for use on small outbreaks; but we may state that the Southern Railway has at present under construction a number of "tank trains" consisting of six standard trucks, carrying rectangular tanks of water, the tanks being coupled together with flexible hose pipes and connected directly to the suction inlet of the pump, with shut-off valves of entirely frostproof design on each tank.

Such a supply would be sufficient for outbreaks of considerable dimensions. It could be augmented by supplies always available in railway yards and depots. For the latter purpose three 20ft. lengths of flexible suction pipe are carried in hamlets round the front of the locomotive, while a sufficient supply of delivery hose and other fire-fighting gear is stowed in steel compartments on the rear offside of the locomotives.

We understand that one of these "locomotive fire engines" was recently in action for a considerable period dealing with a large fire at one of the company's depots, where it demonstrated its usefulness for the purpose for which it was supplied.

Engineering Economics and Æsthetics

THE Council of the Institution of Civil Engineers has recently given consideration to the need to foster amongst engineers the closer study of—

(*a*) the economics of engineering projects;
(*b*) the organisation and management of engineering work; and
(*c*) the relations of æsthetic considerations to engineering design and construction.

In the past, these three subjects have not generally been included in an engineer's education and training, but have been left to be acquired by practical experience spread over many years. Together they include many aspects of engineering work which require to be kept continuously under review in the light of changing economic conditions and the incidence of scientific research on the use of materials and on design.

The Council believes that in the period of reconstruction and development which will follow the present war, these subjects will become of increasing importance, and in the national interest should form a part of the equipment with which engineers should be furnished in order that they may adequately play their part in the task before them.

The Council accordingly intend to examine all possible means by which the Institution can influence the better understanding of engineering economics and æsthetics, not only by students resident at the universities, but also by those otherwise engaged in their engineering training, so that eventually a study of these subjects may form an integral part in the recognised education of all engineers.

As a commencement, the Council approached the Vice-Chancellor of Cambridge University with an offer to finance for a period of five years a lectureship on the subjects envisaged in the hope that they would in due course form part of the engineering curriculum of the Mechanical Sciences Tripos. The proposal was cordially welcomed, and has now been accepted in principle by the Council of the Senate of the University, but its full adoption will necessitate some reconsideration of the scheme of instruction in the Engineering School and possibly of the Mechanical Sciences Tripos, which it would be impracticable to undertake in wartime. It is proposed, however, that a beginning should be made in the next academical year, commencing in the autumn, by inviting a number of eminent engineers and others to visit the university to give either single lectures or short courses on subjects coming within the terms of the proposal.

INSTITUTION OF NAVAL ARCHITECTS.—A research scholarship of the value of £250 per annum and tenable for two years has been founded by the Wrought Light Alloys Development Association to encourage and facilitate research in the application of light alloys to ship construction. The scholarship will be administered by a committee of the Institution of Naval Architects, and it is hoped to make the award in September, 1941. Full particulars of entry, which closes on July 31st, can be obtained from the Secretary, Institution of Naval Architects, 10, Upper Belgrave Street, London, S.W.1.

INSTITUTE OF FUEL: STUDENTS' MEDAL.—To encourage the preparation of papers by students of fuel technology, the Council of the Institute of Fuel has decided to make an annual award of a medal, together with a prize consisting of books and/or instruments to the value of £5, for a paper submitted by a student member of the Institute or by a student under twenty-five years of age of any university or technical college in the United Kingdom. The paper shall deal with some subject relating to the preparation or utilisation of fuel, or allied subjects. Papers must be received by the Secretary on or before September 1st in any year. Papers are limited to a maximum of 6000 words, and may be illustrated by line drawings or photographs. Details of the rules governing the award can be obtained from the Secretary, The Institute of Fuel, 30, Bramham Gardens, London, S.W.5.

New Steel Distribution Scheme

THE Ministry of Supply, Iron and Steel Control, has issued the following information regarding a new steel distribution scheme :—

AUTHORISATION PROCEDURE

All acquisitions of finished steel of the classes listed in Appendix A, whether for direct Government contracts or for any other purposes, require an authorisation on Form M (or Ma in the case of alloy steel). This can only be obtained either directly from a Government Department or through a firm or person who has received authority from a Government Department to issue such an authorisation. A list of the Government Departments responsible for issuing authorisations for various purposes is given in Appendix B.

An authorisation enables the holder, for the purposes named on the form, either to acquire finished steel directly up to the tonnage and in the period specified, or to issue sub-authorisations, also on Form M, for any part of the tonnage. Firms requiring to issue sub-authorisations can obtain the necessary copies of Form M, bearing the name of the Government Department and the Department symbol from the Government Department direct or through the firm from whom they received their own authorisation.

The holder of an authorisation on Form M has authority to quote on his order the particulars necessary for acquiring finished steel. These are the symbol of the Government Department concerned, the Department authorisation number, the delivery period number, and the statement "authorised on Form M." It should be specially noted that the contract or other reference numbers of a Department are not sufficient and cannot be used to acquire steel. The only particulars that can be quoted for this purpose are those set out on an authorisation on Form M.

If a supplier of finished steel is unable to accept an order for delivery in the period authorised, the customer may place the order for delivery in a later period, provided he immediately notifies the issuing Department (through any contractor from whom the authorisation was received), and that Department does not object. This arrangement does not, of course, apply if the order is not placed before the end of the period authorised. In such a case, the authorisation is no longer valid, and a new authorisation is required.

The only exceptions to the use of Form M are the licences issued by the Iron and Steel Control, the allocations issued on behalf of the Ministry of Food and the Board of Trade by the Administrator of Tinplate Distribution on Forms ATP/- and ABNP/-, the authorisations issued by the Ministry of War Transport Surveyors on Form S.25/A, and certain modifications of the procedure which apply to firms who purchase only very small quantities of steel. It should also be noted that Department symbols, &c., cannot be used by stockholding merchants in purchasing finished steel products for their stock. For this purpose they require a licence from the Iron and Steel Control.

June 20th, 1941.

Ref. S.S.20.

APPENDIX A

LIST OF FINISHED STEEL PRODUCTS

Ingots, billets, blooms and slabs (when not for conversion into the other products listed below).

Plates, medium plates, angles, channels, tees, joists, piling sections, other sectional material; rounds, rods, squares, hexagons, flats, other sections and shapes (and whether black or bright); rails, sleepers, fish-plates, sole-plates.

Sheets, coated and uncoated, less than 3 mm. thick, including galvanised, lead-coated, R.P.M., and Cellactite sheets.

Tin-plates (including tinned sheets), terne plates (including terne sheets), black plates (including silver finished plates).

Shell steel ingots, billets, blooms, and bars.

Steel tubes and pipes (including imported hollows).

Hoops, strip (and whether coated or uncoated, and whether hot or cold rolled).

Tyres, axles, wheels.

Steel castings, forgings, stampings.

Colliery arches and accessories therefor, pit props.

Steel bolts, nuts, screw studs, washers, rivets, and screws.

Railway springs (and whether laminated or coiled).

Wire rods, coated or uncoated wire, whether plain or barbed, wire rope, wire strand, wire netting, wire chain link fencing, wire mesh, wire nails, excluding boot and shoe grindery, wire staple, excluding machine staple.

Constructional steel, whether fabricated or not, for inclusion in the structure of a building.

(NOTE.—High-speed steel, containing 14 per cent. or more of tungsten is not covered by the Steel Distribution Scheme. It can only be acquired under licence from the Iron and Steel Control.)

APPENDIX B

HOME OFFICE, Whitehall, London, S.W.1.—Police stations, prisons, approved schools, fire brigades (including Auxiliary Fire Services).

MINISTRY OF HOME SECURITY, Cornwall House, Stamford Street, London, S.E.1.—A.R.P. Services, including Scotland, for which Ministry of Home Security is responsible, camouflage, screening blast-furnaces and coke ovens (anti-glare), special defence schemes.

ADMIRALTY, P. Branch, Statistics Section, Fernley Hotel, Bath.—Naval requirements, other than works and buildings.

ADMIRALTY, C.E. in C. Department, 39–41, Upper Oldfield Park, Bath.—Naval works and buildings services.

ADMIRALTY, Whitehall, London, S.W.1.—Mercantile shipbuilding and repairs.

MINISTRY OF WAR TRANSPORT SURVEYORS.—Deck and engine-room stores for mercantile marine and fishing vessels (by stores authority on Form S.25/A endorsed with Departmental symbol, serial number, and name of port).

WAR OFFICE, Romney House, Marsham Street, London, S.W.1.—Army buildings, medical stores, fuel, and light, and requirements for any contracts placed or purchases made direct by War Office.

MINISTRY OF SUPPLY, S.S.4.B., The Adelphi, John Adam Street, London, W.C.2.—Ball, cylindrical roller and taper bearings, and precision chains.

MINISTRY OF SUPPLY, Appropriate Raw Material Control.—Machinery and plant of factories engaged in the production of commodities controlled by the Ministry of Supply. Details regarding the raw materials covered may be obtained from the Ministry of Supply, Raw Materials Department, Warwick.*

MINISTRY OF SUPPLY, MACHINE TOOL CONTROL, 35, Old Queen Street, London, S.W.1.—All requirements of manufacturers of machine tools, jigs, gauges, and fixtures.

MINISTRY OF SUPPLY, HAND TOOL DIRECTORATE, The Cedars, Tettenhall, Wolverhampton.—All requirements of manufacturers of hand tools.

MINISTRY OF SUPPLY, T.T.2, Ivybridge House, John Adam Street, London, W.C.2.—Road motor vehicles and components to be used in the manufacture of such vehicles.

MINISTRY OF SUPPLY, T.T.3, Steel House, Tothill Street, London, S.W.1.—Spare parts for road motor vehicles.

THE SECRETARY, MINISTRY OF SUPPLY, The Adelphi, John Adam Street, London, W.C.2.—All other requirements for Army.

AIR MINISTRY, Grand Hotel, Harrogate.—Air Ministry requirements.

MINISTRY OF AIRCRAFT PRODUCTION, Endcliffe Crescent, Sheffield.—Requirements for manufacture of aircraft and all R.A.F. stores ordered by Ministry of Aircraft Production.

MINISTRY OF AIRCRAFT PRODUCTION, Millbank, London, S.W.1.—Buildings (including civil engineering) financed wholly or in part by Ministry of Aircraft Production; machinery and plant engaged on Ministry of Aircraft Production work (including maintenance requirements); all requirements of factories engaged on production of aluminium, magnesium and light alloys.

DEPARTMENT OF HEALTH FOR SCOTLAND, Edinburgh.—Department of Health for Scotland, services, *e.g.*, hospitals, all housing requirements, water supplies, sewerage, &c., provided by local authorities; and public utility undertakings.

SCOTTISH EDUCATION DEPARTMENT, Edinburgh.—Schools in Scotland.*

SCOTTISH HOME OFFICE, Edinburgh.—Police stations, prisons and special area factories in Scotland.*

DEPARTMENT OF AGRICULTURE FOR SCOTLAND, Edinburgh.—Agricultural machinery, implements and buildings, piers and land drainage works in Scotland.*

BOARD OF TRADE, Gas Administration Department, 26, Chapter Street, London, S.W.1.—Gas undertakings (including tools peculiar to the gas industry).

BOARD OF TRADE, Industrial Supplies Department, Millbank, London, S.W.1.—(1) All home civilian trade except where specifically included under another department, including the requirements of factories (other than those working exclusively under the auspices of one Department or producing aluminium, magnesium, light alloys, bricks, cement, or commodities controlled by the Ministry of Supply) for the repair and maintenance of their machinery and plant. Applications for authorisations should be made to the Board of Trade by the actual purchaser of finished steel and not by the purchaser of goods manufactured from finished steel. In the case of certain organised groups of manufacturers the Board of Trade issues a group authority to the Secretary of each group, who in turn issues authorisations to the members of the group. In the case of tin-plates, terne-plates and black-plates for home civilian trade, applications should be made by the actual fabricators to the Administrator of Tinplate Distribution, 50, Charing Cross, London, S.W.1. (2) Indirect export (*i.e.*, export of manufactured articles containing steel), except exports to British controlled oil companies and oil companies operating in the sterling area, Dominion and India Service requirements (which are authorised by the corresponding Departments in this country), agricultural machinery, hand tools, machine tools and motor vehicles and spare parts. In general the Board of Trade either issue group authorisations to the Secretaries of Export Groups who in turn issue authorisations to their members or make arrangements for applications for individual export orders to be submitted through the group. (3) Direct export (*i.e.*, export of finished steel), except to India, to oil companies and for Dominion Service requirements. Applications for exports to the territories for which the following Departments are responsible should be submitted through these Departments :—Burma Office, Whitehall, London, S.W.1; Colonial Office, Downing Street, London, S.W.1; and for requirements of non-ferrous metal mines in the Empire through Non-Ferrous Metals Control, Grand Hotel, Rugby.

PRIORITY OFFICER, MINISTRY OF HEALTH, Whitehall, London, S.W.1.—Hospitals, housing schemes, water supplies, sewerage, refuse collection, &c., provided by local authorities; and public utility undertakings (excluding Scotland).

MINISTRY OF AGRICULTURE AND FISHERIES, Linden Hall Hydro, Christchurch Road, Bournemouth.—Agricultural machinery, implements, buildings and land drainage works (excluding Scotland).*

MINISTRY OF WAR TRANSPORT, Metropole Buildings, Northumberland Avenue, London, W.C.2.—Statutory railways, railway rolling stock (excluding new tank wagons and internal user stock), ports, canals and canal carriers, highways, tramway and trolley vehicle undertakings, works and buildings for inland transport undertakings.

MINISTRY OF FOOD, Westfield, Llanerch Road, Colwyn Bay, North Wales.—Tins and packing material for food, requirements of food factories and of undertakings used for processing, storing and distributing food (including breweries and animal feeding-stuffs); communal and emergency feeding. In the case of tin-plates, terne-plates and black-plates, applications should be made by the actual fabricator to the Administrator of Tinplate Distribution, 50, Charing Cross, London, S.W.1.

MINISTRY OF WORKS AND BUILDINGS, Lambeth Bridge House, London, S.E.1.—Requirements of contractors of the Ministry. Authorisations will be issued to the firms concerned by the appropriate Department of the Ministry.

MINISTRY OF WORKS AND BUILDINGS, Director of Cement and Director of Bricks respectively, Lambeth Bridge House, London, S.E.1.—Steel for machinery and plant (including maintenance and repairs) of cement works and brickworks.

MINISTRY OF WORKS AND BUILDINGS, Regional Licensing Officers.—Private enterprise works of building or civil engineering construction. Lists of the areas covered by the various Licensing Officers may be obtained from any Licensing Officer or from the Licensing Officer, Ministry of Works and Buildings, Abell House, John Islip Street, London, S.W.1.

BOARD OF EDUCATION, Branksome Dene Hotel, Bournemouth.—Schools and other educational institutions in England and Wales towards the cost of which the Board makes a grant (excluding Scotland).*

GENERAL POST OFFICE, Stores Department, 17–19, Bedford Street, London, W.C.2.—Post Office requirements.

MINES DEPARTMENT, Mill House, 87–89, Shaftesbury Avenue, London, W.1.—Mines and quarries under the jurisdiction of H.M. Inspectors of Mines and Quarries; coke ovens and patent fuel plants, except those owned by a steel works or I.C.I.; tar distilleries and low-temperature carbonisation plants; coal dumps; and private lines and sidings and rolling stock used solely for internal traffic within a mine or quarry premises (excluding Northern Ireland).

PETROLEUM DEPARTMENT, Dean Stanley Street, Millbank, London, S.W.1.—British controlled oil companies requirements for home and export, including the packaging and other requirements of the lubricating oil trade, but excluding the "Service" Departments' requirements and the retail distribution of petroleum products in the United Kingdom.

ELECTRICITY COMMISSIONERS, Savoy Street, Strand, London, W.C.2.—Electricity supply industry covering generating stations, the grid and distribution systems.

MINISTRY OF COMMERCE, Belfast, Northern Ireland.—All requirements of local authorities, A.R.P., schools, hospitals, housing schemes, water supplies, sewerage, churches and social centres, agricultural machinery and implements manufactured in Northern Ireland, agricultural buildings, railways and other transport, harbours, canals, electricity and gas supplies, mines and quarries, extension and alteration of factories engaged on essential work (excluding directly sponsored by other Departments listed).

INDIA OFFICE, Whitehall, London, S.W.1.—All finished steel for direct export to India.

LOCAL RECONSTRUCTION PANELS.—Air raid emergency repairs to vital buildings, production plant, machinery and works.† A list of the Local Reconstruction Panels can be obtained from the Ministry of Aircraft Production, Emergency Services Organisation, Millbank, London, S.W.1.

LOCAL AUTHORITIES.—Air raid emergency repairs to other premises.† Local authorities can obtain particulars regarding procedure from the Priority Officer, Ministry of Health, London, S.W.1.

* Except in regard to private enterprise works of building or civil engineering construction (see Ministry of Works and Buildings).

† In the case of permanent repairs application should be made to the Department concerned.

Standardisation of the Declared Calorific Value of Gas

AT the one-day meeting of the Institution of Gas Engineers, which was recently held in London, under the presidency of Mr. George Dixon, Engineer and Manager, City of Nottingham Gas Department, there can be no doubt that the paper of the symposium, "The Gas Industry: 1941 and After" (consisting of nine separate contributions from notable authors), which elicited the greatest interest, was the opening one by the President-Elect, Sir Frederick J. West, of Manchester, on "The Standardisation of the Declared Calorific Value."

The author held that the freedom bestowed upon gas undertakings by the Gas Regulation Act of 1920 to choose and to vary the standard of calorific value of gas sold most suited to all the conditions under

which it was to be supplied, marked a very great advance in the development of the gas industry in England. But while this freedom of choice is of the greatest value, it should not be permitted to go to the length of such diversity of standards as to interfere with the simplification of appliances or to increase the difficulty of the consumer to understand for what he is paying.

Reasons were given for varying the calorific value in different districts, and it was shown that no fewer than twenty-six different values were declared, varying from 200 to 600 B.Th.U. per cubic foot.

The Fuel Research Board, as long ago as 1919, reporting to the President of the Board of Trade, came to the conclusion that there should be no stereotyped standard of calorific value. Some form of standardisation is of great importance, however, for several very weighty reasons. Not the least of these is that of reducing the confusion in the public mind with regard to what the consumer is buying through the gas meter. The public has not accepted the "therm" with any sense of unanimity, and no doubt there are satisfactory reasons why this should be so. The meter records cubic feet, which has to be translated into therms, by the use of a factor which varies often from one gas undertaking to another and sometimes from one side of the street to the other.

Sir Frederick concluded that, if it be conceded that one standard declared calorific value for the whole country is inadvisable, though in many respects desirable, there appears to be a very strong case for a limited number of standards.

He suggested that four values—500, 475, 450 and 425—should suffice to meet all, or very nearly all, requirements. An analysis of official returns showed that about 80 per cent. of the gas supplied by the three metropolitan companies and the six principal London suburban companies is sold at a declared value of 500 B.Th.U. per cubic foot. This represents about one-third of the total volume of gas sold in this country.

An animated discussion followed. All the nine papers of the symposium having been circulated to members were taken as read.

As to the clarification of the mystification in the minds of consumers through not understanding how their accounts were made up, Mr. Walter T. Dunn, in a written contribution to the discussion, suggested that the dials of gas meters should be altered to read therms instead of cubic feet. The charge would thus be clearly indicated.

The Home Guard and Factory Defence Matters

THE Electricity Commissioners have been notified by the War Office that Liaison Officers have been appointed on Command Headquarters, as is shown in the list given below, to deal locally as far as possible with the Home Guard and factory defence matters in the case of factories and undertakings for which the various Government Departments are responsible. Any Home Guard problems and suggestions which electricity undertakers have usually referred to the Commissioners should in the first instance be referred in future to the Factory Liaison Officer in their locality, who will subject to Command Headquarters views dealing with such problems and suggestions. The list of Commands and Liaison Officers is given as follows :—

Eastern Command.—Lieut.-Col. A. R. Thompson, M.C., Watergate House, Adelphi, W.C.2. Telephone, Ger. 6933, Extension 794.

South-Eastern Command.—Lieut.-Col. T. Donnelly, D.S.O., Watergate House, Adelphi, W.C.2. Telephone, Ger. 6933, Extension 794.

Western Command.—Capt. The Lord Carnegie, K.C.V.O. Staffs, Salop, Warwick, Worcester, Hereford : Lieut.-Col. W. de L. Passy, 20, Norfolk Road, Edgbaston, Birmingham. Telephone, Edgbaston 2981. Cumberland, Westmorland, Lancashire, Cheshire : Lieut.-Col. J. C. Brewer, M.C., Lieut.-Col. C. B. Mosse, Britannia House, Fountain Street, Manchester, 2. Telephone, Deansgate 4343, Extension 69.

Wales.—Lieut.-Col. A. I. G. McConkey, Halidon House, Abergavenny, S. Wales. Telephone, Abergavenny 349.

Scottish Command.—Lieut.-Col. W. L. Stewart-Meiklejohn, 21, Glassford Street, Glasgow, C.2. Telephone, Bell 3586.

Northern Command.—Northumberland, Durham, North Riding of Yorkshire : Major F. E. Davies, M.C., Clarendon Buildings, West Clayton Street, Newcastle-on-Tyne. Telephone, Newcastle 27623. East Riding and West Riding of Yorkshire : Lieut.-Col. V. Cambier, Queen's Buildings, Queen Street, Sheffield, 1. Telephone, Sheffield 22884 and 20720. Derby, Lincoln, Notts, Leicester, Northampton, Rutland : Major M. J. T. Reilly, M.C., 2, Carrington Street, Nottingham. Telephone, Nottingham 45721.

Southern Command.—Lieut.-Col. P. D. Green-Armytage, Royal London House, Queen Charlotte Street, Bristol. Telephone, Bristol 23718.

OIL SITUATION IN THE MIDDLE EAST : CORRECTION.—Col. 2, page 334, May 23rd, 1941. Owing to a slip in conversion, the oil production in Russia in 1939 was given as 4,433,000 tons. It should have been 30,000,000 tons.

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quantities are f.o.b. steamer

Steel Stocks Census

Under its statutory powers the Ministry of Supply, Iron and Steel Control, is to take a census of steel stocks on June 30th, 1941. This census will, in general, follow the lines of the one held at the end of 1940, which yielded results of the greatest value in formulating Government policy in regard to supplies of steel. Some 30,000 firms will be affected. Consumers are asked to complete and return the form by July 7th, 1941. The form is not being sent out to finished steel producers, structural engineers and stockholding merchants, as these all come within the purview of the Iron and Steel Control and figures of their stocks are regularly available. The census form, properly filled, must be returned to the Iron and Steel Control by July 7th, 1941. If a firm's total stock is less than 5 tons the form should be marked "Under 5 tons," and no further particulars entered, except the name, address and signature of the firm. The steel products to be included in the census are :—Drop forgings (carbon and alloy) ; alloy steel in the form of castings ; forgings (except drop forgings) ; sections, bars, sheets, strip, wire and tubes ; armour plate ; high-speed steel ; nuts, bolts, screws, rivets, washers. All other steel in the form of plates, medium plates, sheets (coated or uncoated) ; rails, fish-plates, sole-plates, sleepers ; angles, tees, channels, sections ; girders, beams, joists, pillars ; bars, rounds, squares, hexagons, flats, rods ; steel arches and accessories ; pit props ; shell steel ingots, billets and forgings ; tubes and pipes ; hoop and strip (hot or cold-rolled) ; bright steel bars ; railway tyres, wheels and axles ; railway springs ; forgings (except drop forgings) ; castings ; nuts, bolts, screws, rivets, washers ; wire rods ; wire (coated or uncoated) ; barbed wire ; wire rope, strand, netting, fencing, nails and staples ; constructional steel, whether fabricated or not.

The Pig Iron Market

Expectations that an advance in the price of pig iron will be announced are voiced in many directions. So far there has been no official statement as to the future price of blast-furnace coke, which, of course, will be an important factor in fixing pig iron quotations. An increase in coke prices is regarded as certain, as other industrial coke prices have been increased by 1s. 3d. per ton. Only a moderate volume of business is passing in pig iron and buyers have to agree to pay the official price ruling on the date of despatch. The demand for foundry pig iron is steady and this quality is now being used for a number of purposes for which in pre-war days consumers did not consider it suitable. Supplies, however, are adequate. Several districts draw practically all their supplies of foundry iron from the Midlands, and the makers in that district are understood to have accumulated fair stocks. At any rate, there is no suggestion that the Cleveland makers of foundry sorts, which is on a limited scale, should be increased. In the Midlands the light castings industry is still poorly employed. Not long ago there was a move to bring this industry into the war effort and it was hoped that Government contracts would absorb some of the unemployed capacity of the industry. Apparently the light castings foundries are not suitable to undertake more than a limited amount of the class of work required by the Government. If there is any tightness in the pig iron position, it is in the low phosphorus and hematite categories. Some improvement has been noticeable in the demand for high-phosphoric pig iron, as larger quantities of this description have been called for by the engineering foundries, which have been asked by the Control to use it wherever possible as a substitute for low-phosphoric and hematite sorts. There is an active demand for the two latter sorts of irons from the heavy engineering and associated industries. Refined irons are called for in increasing quantities and the demand is met in part by imported material. Large quantities of basic iron are passing to the steel works, and in spite of the heavy demand the supply position does not give rise to any anxiety. The home production has been considerably increased over the normal peacetime output and has been supplemented by substantial imports.

Scotland and the North

The Scottish steel makers are operating at capacity and large outputs are being obtained. All plant that could possibly be brought into operation has been working for some time. Whilst business continues to be offered in large volume, practically no fresh orders can be booked for delivery for inclusion in the second delivery period, which ends on June 30th. Allocations, however, have been made for the third period and the producers are assured of extremely active conditions for some months ahead. An outstanding feature of the steel position is a strong demand for plates. Ship, tank and boiler plates are keenly sought after and very large tonnages are passing to the shipyards, which have a big programme of constructional and repair work in hand. The position so far as heavy structural steel is concerned is regarded as fairly satisfactory under the existing conditions ; the demand is not more than moderate and deliveries can be made fairly promptly. The call for light joists and sections is good and considerable quantities are passing to the consuming trades. All branches of the engineering industry are fully employed in nearly every case upon war work. This section of industry is absorbing very considerable quantities of sections, bars and castings. The demand for special alloy steels, which has been a feature of the market for some weeks, is still steadily expanding as the demands from munition and armaments makers increase. Businesss in tubes and pipes is brisk and the works are actively engaged for some time. In the Lancashire district the activity in the steel industry is increasing and there is a particularly sharp request for alloy steels. Importations of American steel have helped to ease the situation, and amongst the classes of American steel which have been freely distributed are considerable tonnages of special steels. Boilermakers and tank makers are large consumers of plates, and this demand seems likely to continue for some months. The steel works in the North-West Coast are busily engaged largely upon material for Government contractors.

The Midlands and South Wales

All the steel works in the Midlands are fully employed and these conditions rule at the re-rolling mills as well as at the heavy steel works. The busy conditions prevailing at the shipyards have created an extremely heavy demand for billets and sheets, and the call for plates in particular is a feature of the position. Sheet makers have been busy for months principally on Government orders and there is no slackening in the volume of business coming forward. The careful distribution of iron and steel and the restriction upon its use for unessential work has made the situation easier in several directions. The position so far as heavy joists are concerned is still rather on the quiet side, but light joists and sections are in heavy demand and as a result of the limitation of supplies to essential war purposes the firms engaged on this class of work are receiving earlier deliveries in most classes of structural steel than was the case a short time ago. Most constructional engineering firms are busily employed and are taking large tonnages of steel. The development in the demand for special steels has continued and important quantities are passing steadily to the engineering industry. The production of bright-drawn steel has been increased, and the position, so far as deliveries are concerned, has distinctly improved. Business in colliery steel is active, and although the total demand may be less than at this time last year, big tonnages of props, roofing bars, &c., are passing to the collieries. The iron and steel trade in South Wales is operating under high pressure and practically the whole production is passing into consumption for national purposes. In the heavy finished steel department makers are being pressed to accelerate deliveries. The demand for billets is at a high level, but the home production is supplemented by imports from the United States and the position is not unsatisfactory. The tin-plate trade is not so busy as it was a few months ago and the works operations are restricted by the limitation of the quantities of steel allocated to them. Some good export orders, however, have lately come into the market and there has been a good deal of inquiry. Sheet makers are busily employed and most of them are engaged almost entirely upon priority orders.

Copper and Tin

The consumption of copper in Great Britain continues on a heavy scale. Supplies, however, are sufficient to meet all requirements, and although the non-ferrous metal control exercises care in the distribution and little copper is available for other than war purposes, the situation is regarded as comfortable. In the United States the war industries are operating at top speed and copper in that country is becoming rather tight. No copper now is available for export. The prices are unchanged at 12c. for domestic delivery and 11c., nominal, for export. The retention of the 12c. price is believed to be due to the influences of the American Government, which does not wish prices to be raised above that level. All transactions in copper in the United States are subject to priority and, of course, it is necessary to obtain an export licence. South American copper is coming in and it seems possible that the whole of the production of the United States owned mines in South America will be required for the national defence programme in the United States. Some discussion has taken place regarding the opening of mines which have been shut down for some time, but this is not regarded favourably, as it would necessitate an increase above the price of 12c. The outbreak of hostilities between Germany and Russia, however, may influence the position, although up to the present Russia's copper requirements have not made themselves felt. It is probable, however, that they will do so later on. . . . The decline in prices in the tin market was short-lived and most of the ground lost has been recovered. The contango has widened and this is regarded as a more healthy condition than when a backwardation ruled. At the beginning of the month prices were about level. A contango of 10s. developed early in the second week of the month, which has now increased to £2 5s. No export licences are being granted for the time being and apparently the authorities think it necessary to keep good supplies of tin in the country.

Lead and Spelter

The lead position in Great Britain is satisfactory, and not only are there good quantities of virgin metal available, but there are also large quantities of scrap metal. Large quantities are being consumed in the war effort, but supplies are distributed in adequate quantities and with regularity. Not only are the war industries well catered for, but firms producing lead products for export are also able to obtain metal. In the United States the market is somewhat tight and it is calculated that the existing stocks are not more than sufficient for a few days' supply at the current rate of production. . . . Rather tight conditions rule in the world spelter position, but in Great Britain consumers engaged upon war work have their full requirements provided by the Control. The tight conditions which rule in most consuming countries has resulted in an active export demand, but no metal appears to be available for overseas consumers, either from Great Britain or the United States. In the latter country stocks are at a low level and some concern is expressed regarding the future, but as the year goes on a considerable amount of new plant will be brought into operation and production should be considerably increased by the autumn.

Notes and Memoranda

Rail and Road

MANCHUKUO BRIDGE.—Plans are afoot to construct a railway bridge over the Yalu River at an estimated cost of £88,000. It will connect the Chosen and Manchukuo railway systems, and is expected to be completed in two years' time.

THE NEW "SOUTHERN" ENGINE.—The first two of Mr. Bulleid's new "Pacifics" on the Southern Railway are, as anticipated, being used to operate heavy mineral trains. In the words of a running shed foreman, they are "capable of moving the whole city."

TRANSPORT PRIORITY FOR SPARE PARTS.—The Director-General of the Ministry of War Transport makes the announcement that spare parts and units for motor vehicles (new, reconditioned or for reconditioning) have now been added to the list of "essential traffics" which are accorded priority of transit by rail. Such parts and units should be described on the consignment note as "spare parts/units for road transport vehicles."

THE CONSIGNOR TO PAY?—The Railway Executive Committee has submitted to the Ministry of Transport a proposal that all goods carriage accounts should be rendered by the sending station to the consignor, and that no carriage accounts would be rendered to the consignee. The Ministry of Supply is seeking the opinion of the Raw Materials Controller, pending his decision on the proposal designed to expedite delivery and effect economies.

FROM "LOCO." TO TANK.—The Baldwin Locomotive Company, of America, has handed over to the authorities its first tank. This is described as a medium "M-3" combat tank. It weighs 29 tons and is powered by a 400 H.P. radial Wright "Cyclone" engine. It carries a crew of seven and a battery of guns, including a 75 mm. semi-automatic, a 37 mm. semi-automatic, and four 30-calibre machine guns. The tank was turned out at the plant three-quarters of a year ahead of schedule.

IDEAS IN PLENTY.—Three months ago the Pullman Company, of America, instituted a revised employees' suggestion system, under which all employees of the company are eligible for awards except supervisory officers and other employees whose work involves research or development of new methods and ideas. Within one month 3500 suggestions were sent in and the examining committees have recommended 140 suggestions and of these, forty-one won cash awards ranging from 5 to 100 dollars.

EXHIBITIONS ON TOUR.—Last autumn there was shown at Charing Cross Underground Station a railway exhibition coach in which were hung over 100 photographs illustrating the many activities and problems of the railways in wartime. The coach, painted a distinctive blue and bearing the words "British Railways Exhibition Coach," is now to go on tour, and as a start it was stationed at Liverpool Street. Another war train exhibition has been touring the Union of South Africa and Southern Rhodesia to demonstrate by means of a variety of exhibits different aspects of South Africa's war effort. It comprised munitions in variety and armoured cars produced in Union workshops.

AUSTRALIA AND PRODUCER GAS.—In the early part of 1940 the Council for Scientific and Industrial Research (Commonwealth Government of Australia) appointed a Technical Committee under the Chief of the Division of Industrial Chemistry to standardise, *inter alia*, methods for testing both charcoal and producer gas generators, using charcoal which can be made from any Australian hardwood. Under the auspices of the Council of Scientific and Industrial Research, Professor A. F. Burstall, of Melbourne University, is engaged on research work in measuring the actual wear in cylinders using producer gas as compared with petrol. The results so far support the claim that wear with producer gas is no greater than with petrol or other liquid fuels, provided an efficient type of gas filtering and cleaning device is embodied.

PRODUCER GAS TRANSPORT.—Sweden is continuing and extending producer gas transport. As recently as November of last year the total number of converted vehicles had reached 18,225, including nearly 5000 taxis and private cars. Over 30 per cent. of the lorries, 28 per cent. of the buses, and 18 per cent. of the private cars were then operating on producer gas. Fresh figures issued at the end of March show 45,000 vehicles, or 90 per cent. of the road vehicles in the country, were operated on producer gas from charcoal and wood for the most part. Meantime a Brazilian law stipulates that, for each group of ten commercial vehicles owned, one must be producer gas driven, and more recently the Minister of Agriculture requires all commercial vehicle owners to comply within a period of six months dating from January 15th, 1941. Producer gas equipment is now being made in Brazil.

SEALING EXPANSION JOINTS.—The Canadian Highway Research Board has received from Mr. John S. Crandell, of the University of Illinois, a report on filling and sealing of expansion joints. It is based on experiments conducted at the university and covers the following types of joint fillers:—(*a*) tar, (*b*) tar plastic, (*c*) poured rubber, (*d*) various asphaltic fillers, (*e*) pre-moulded rubber, (*f*) boards, (*g*) oil latex, (*h*) chlorinated tar and rubber, and (*i*) synthetic rubber and asphalt. The effect of the surface texture of the joint due to finishing on the adhesion of the filler was commented on, and a type of the joint cutting device to overcome this fault was described. The tendency of fillers to be whipped out of joints by high-speed lorries and cars, with their intricate tyre tread design, is greater to-day than formerly. A sealing material has to withstand not only this whipping action but the weather, the effects of freezing and thawing, the contraction and expansion of the concrete slabs and other items which tend to break down the filler. The ideal filler is yet to be found, and the ideal method of cutting joints or preparing them for the filler is not yet developed.

Air and Water

SHIP LOSSES.—The Board of Admiralty regrets to announce that H.M. drifter "M. A. West" and H.M. trawler "Sindonis" have been sunk. There were no casualties in H.M. drifter "M. A. West."

SHIPPING WESTWARD.—With stocks of china clay accumulating in Cornwall an effort has been made by the owners, the Ministry of Transport, railway companies and officials of the Transport and General Workers' Union to find relief for the glut, and arrangements have now been worked out under which 200,000 tons of china clay may be sold and sent to American papermaking concerns.

ANOTHER WATER POWER SCHEME.—A report has been sent to Congress and to President Roosevelt recommending the construction of a "multi-purpose power and irrigation dam" on the Colorado River, 67 miles downstream from Boulder dam, at a cost of 41,200,000 dollars. This project is to meet growing population needs and national defence requirements in the region. An appropriation of 5,000,000 dollars is sought to begin construction work on the project, which will have a power capacity of 225,000 kW.

WATER POWER IN AMERICA.—Recently collated statistics point to the fact that the United States led the world at the end of 1940 in the horse-power capacity of water wheels in water power plants. With an installed capacity of 19,000,000 H.P. in water wheels, this nation had more than twice as much water wheel power as Canada, in second place. Canada was rated as having 8,584,000 H.P., with Italy in third place with 6,250,000. The total capacity of water wheels in power plants throughout the world was 69,400,000 H.P. at the end of 1940, against 23,000,000 H.P. at the end of 1920.

A BIG COMBINE.—A group of contractors well fitted to undertake big engineering projects has been constituted as Panama Contractors, Inc., in order to carry through the 22,000,000 dollars dredging contract for the third set of Miraflores locks at Panama. This combination is regarded as unnecessarily big for the dredging contract, and current opinion thinks that it intends to bid on the construction of the new locks themselves when this 250,000,000 dollars or so job comes along perhaps next year. Already established on the ground, Panama Contractors would be in a good position to go after the job. It is doubtful whether contractors could be found, outside the syndicate, who would be able to tackle a project of this magnitude.

Miscellanea

MINING AND METALLURGY IN BRAZIL.—The President of Brazil has decreed a National Mining and Metallurgical Council, to be composed of native Brazilians. Its objects are the study of problems of the mining and metallurgical industry.

STREET LIGHTING AND OVERHEAD WIRES.—A case has recently occurred in which a pole carrying low-tension distribution and street lighting wires was damaged by enemy action with the result that the street lighting circuit became energised and lamps—which had not been removed—were lit up. To avoid any possibility of this happening, street lighting authorities should be advised that all lamps not in use should be removed or the fuses removed from individual lamp circuits.

GERMAN MAGNESIUM PRODUCTION.—The production of magnesium in Greater Germany during 1940 is reported to have increased to between 16,000 and 19,000 metric tons. The electrolytic magnesium chloride process has been employed, but experiments were begun recently on the direct thermal reduction of magnesium oxide. Owing to lack of certain other metals, Germany uses magnesium for telephone switch parts, optical instruments, microscopes, bus-bars, and aerial bombs.

MAGNESIUM FROM MAGNESITE.—Encouraged by laboratory research and tests, the U.S. Bureau of Mines is to proceed with further tests of a special process for the production of magnesium metal by direct reduction from magnesite ore. A small pilot plant, designed to produce from 50 lb. to 100 lb. of the metal daily by the electro-thermic method, has been erected. If operations are successful, sufficient data may be made available to determine the feasibility of production on a commercial scale.

MORTARS FOR BRICKWORK.—Wartime Building Bulletin No. 16, "Jointing Mortars for Brickwork"—H.M. Stationery Office, price 3d.—discusses special problems that arise in wartime in selecting mortars for brickwork. The factors usually considered are the strength required of a wall, the rate at which it is required to develop, weather conditions at the time of building, weather resistance of the wall, availability of materials, ease of workmanship and cost. In wartime there must be added, in many cases, the question of blast and splinter protection. All these factors are considered in the Bulletin and definite recommendations are given for a number of different classes of work, *e.g.*, air raid shelters, walls to carry heavy loads, normal and load-bearing walls, non-load-bearing walls, parapets and walls below damp-proof course. In case it should again become necessary to economise in cement, limits are given below which it is inadvisable to reduce the cement content. The recommendations are summarised in the form of a table.

INSTITUTE OF TRANSPORT.—The Metropolitan Graduate and Student Society of the Institute of Transport has arranged the following programme of meetings for 1941–42. These meetings are to be held on Saturday afternoons at 2.15 p.m. at the Institution of Electrical Engineers:—October 25th, 1941, address by the President of the Institute; November 8th, "Basic Principles of Schedule for Road Passenger Transport," by H. F. Adcock; December 13th, "Air Raid Precautions as Affecting Goods Road Transport (Horse and Motor)," by N. W. Sharratt; February 14th, 1942, "The Problems of Post-war Transport," by S. B. Budworth; March 14th, "Railway Goods Department Claims," by A. W. Satchell.

SALVAGE DURING APRIL.—The necessity for fuller co-operation in salvaging paper, metals, and bones is reflected in the salvage returns for April. During April kitchen waste collected by Councils was the only item to show an improvement over the figures published for March. The amount rose to 11,370 tons, as against 11,279 tons, and 410 Local Authorities are now making collections. Paper sold by Councils amounted to 22,445 tons, valued at £94,761, against 24,099 tons in March; metal to 21,936 tons, valued at £54,743, as against 22,169 tons; and bones to 963 tons, as against 981 tons. The above figures of sales cover only collections by Local Authorities. They do not include material collected direct by merchants, nor do the metal returns include the village dump or railings schemes.

Personal and Business

SIR GEORGE HIGGINS has been re-elected chairman of the general committee of Lloyd's Register of Shipping.

LORD ROTHERWICK has been elected Chairman, and Mr. J. R. Hobhouse Vice-Chairman, of the General Council of British Shipping.

THE IGRANIC ELECTRIC COMPANY, Ltd., informs us that its London address is now Bush House (N.W. Wing), Aldwych, W.C.2. Telephone, Temple Bar 1961.

WELLWORTHY PISTON RINGS, Ltd., informs us that its offices and works are now at 64A, Woodcock Street, Birmingham, 4. The new telephone number is Aston Cross 2675–6.

THE MINISTER OF WORKS has appointed Mr. G. W. Mitchell to be Controller of Building Materials, in succession to Mr. Hugh Beaver, now Director-General, Works and Buildings.

DAVEY, PAXMAN AND CO. (COLCHESTER), Ltd., announce that Mr. W. A. Sycamore has been appointed sales manager, and Mr. A. C. Parker, London manager and deputy boiler manager.

THE COAL UTILISATION JOINT COUNCIL informs us that its address is now 54, Victoria Street, London, S.W.1. Telephone, Victoria 9851 (two lines); telegraphic address, "Promocoal, Sowest, London."

SIR PETER BENNETT has been appointed Chairman of the Automatic Gun Board, which will co-ordinate production for all the Ministries concerned. His address is Office of the Minister of State, Great George Street, S.W.1.

NEW HEADQUARTERS.—The International Hydrogenation Engineering and Chemical Company, the International Hydrogenation Patent Company, and the Bataafsche Petroleum Mij. have transferred their registered headquarters from the Netherlands to Curacao.

SIR AMOS AYRE, formerly Director of Merchant Shipbuilding and Repairs at the Admiralty, has been appointed Deputy Controller of Merchant Shipbuilding and Repairs and Director of Merchant Shipbuilding. Mr. Lawrence Edwards has been appointed Director of Merchant Ship Repairs.

MR. CHARLES WILLIAM JEFFRIES, F.R.A.S., Director of the Royal Observatory, Hong Kong, since 1932, died suddenly in Hong Kong on Sunday, June 22nd. He was born in 1882, and after serving at the Royal Observatory Greenwich, and the Royal Observatory, Cape of Good Hope, went on to the Hong Kong Observatory as First Assistant in 1907.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Institution of Civil Engineers

Saturday, July 12th.—YORKSHIRE ASSOC.: Hotel Metropole, Leeds. Luncheon. "The Lennox Road Refuse Disposal Station," W. S. Cameron. 1 p.m.

Institution of Electrical Engineers

Saturday and Sunday, June 28th and 29th.—N.E. STUDENTS: Summer visit to the Lake District.

END OF VOL. CLXXI

THE ENGINEER, JUNE 27, 1941
Printed on thin paper for overseas circulation.
With METALLURGICAL SUPPLEMENT

JUL 14 1941
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The Engineer

VOL. CLXXI.—No. 4459 28, ESSEX ST., STRAND, LONDON, W.C.2 JUNE 27, 1941

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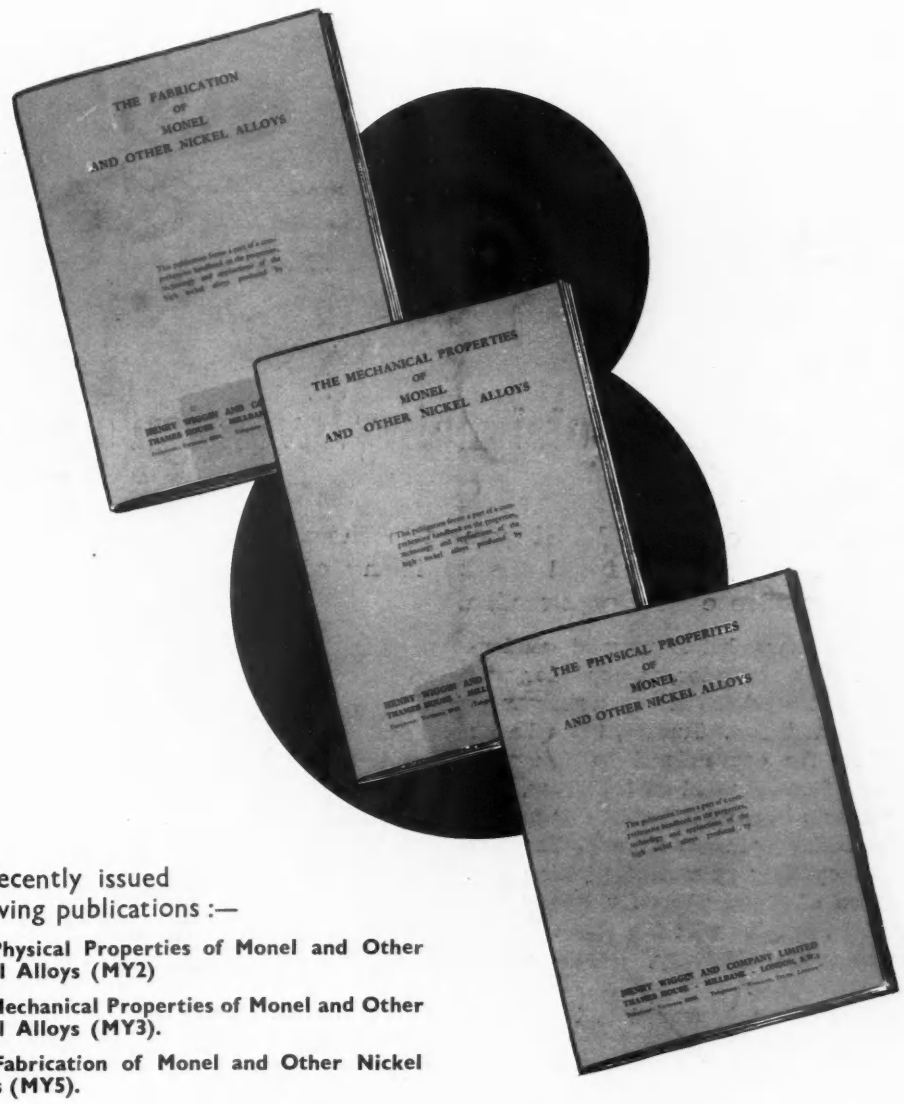

We have recently issued the following publications :—

The Physical Properties of Monel and Other Nickel Alloys (MY2)

The Mechanical Properties of Monel and Other Nickel Alloys (MY3).

The Fabrication of Monel and Other Nickel Alloys (MY5).

The titles are self-explanatory.

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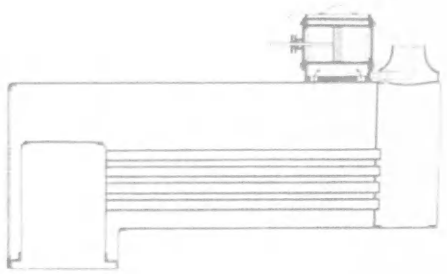

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It is not often that an industrial concern mentions an order that it refused to execute, but we believe that readers may be interested to hear of such an instance.

It comes from Tangier, where two Italian submarines, damaged by British gunfire, took refuge. The incident, at one juncture, seemed likely to cause international complications.

We now learn that the Italians tried every ruse to obtain supplies of "Bitumastic" with which to complete their repairs and they sent as their first emissary a Spaniard who had been engaged in the repair work.

Our agent at Tangier, knowing the Spaniard, asked him for his word of honour that the Solution would not be used on the Italian vessels. This the Spaniard refused to give, and the two containers of "Bitumastic" that he had taken away in his car were returned on the following day.

There followed a procession that had a League of Nations air about it. An Italian of the Tangier Administration came to try and buy the Solution, but was sent away empty-handed. Next came a Frenchman, and finally another Spaniard, but they had no better luck.

The repaired Italian submarine eventually departed—minus their protective coating of "Bitumastic" Solution. Our agent adds that the good qualities of "Bitumastic" products are so well known in Tangier that there is a constant demand for them. We are always happy to supply our customers—but we draw the line at enemy submarines!

Here's a good war story—and a true one. For 86 years we have waged relentless war against corrosion with "Bitumastic" or others of our special anti-corrosion preparations. Evidence of our victories may be seen in all quarters of the globe. Little wonder, therefore, that our enemies eagerly sought an ally so successful. But they didn't get the "Bitumastic" they so sorely needed . . . and so for the first time in our history we are pleased to leave corrosion, rot and decay to do their worst.

●

Incidentally the article reproduced here is from "The Protector," our house journal, which is full of interesting reading. May we send you a copy? Write to Dept. E.21. Just say "March issue of 'Protector,' please."

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Low-pressure cylinder, 51in. dia.

Stroke, 5ft.

Designed working pressure, 120 lb./sq. inch

Normal rating, 1,200 H.P. at 65 r.p.m.

Cylinders steam jacketed

Corliss valves

Fly-wheel, 24ft. dia., grooved for 30—1¾in. dia. ropes, constructed with loose boss arms and segment

Weight of fly-wheel, 39 tons

Weight of engine, less fly-wheel, 112 tons

Equipped with barring engine, 7in. dia. x 8in. stroke

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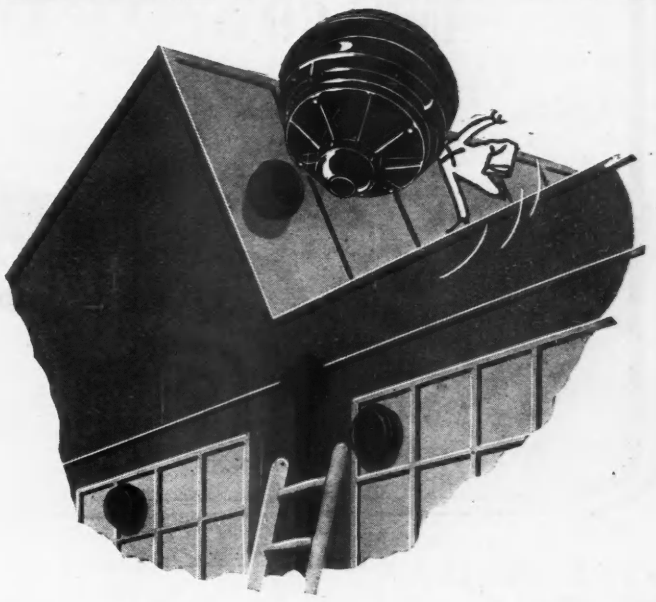

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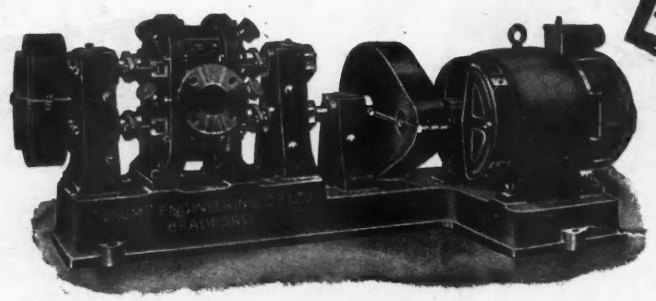

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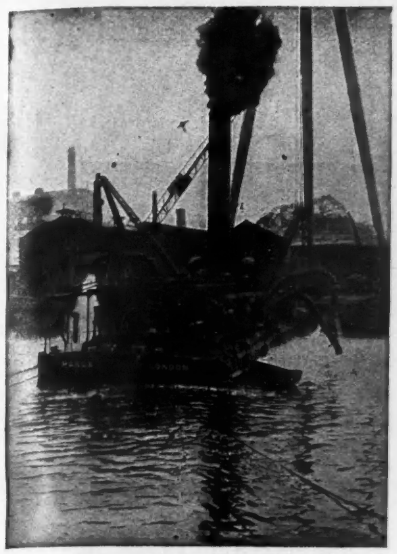

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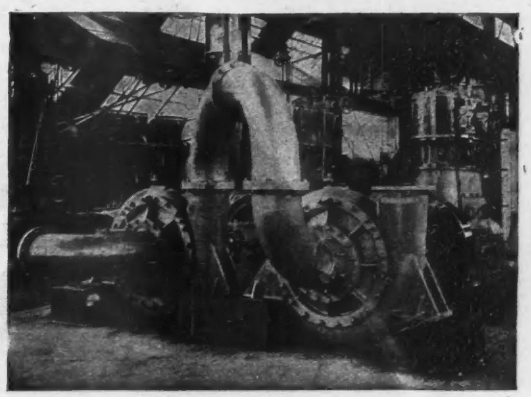

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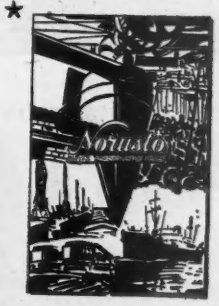

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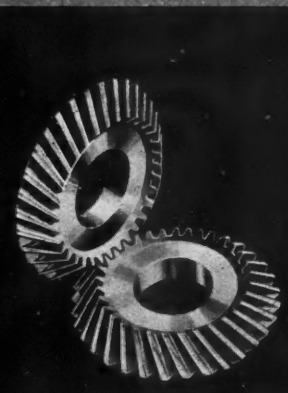

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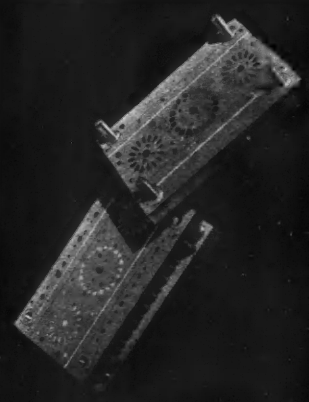

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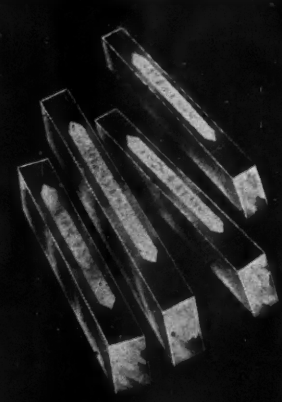

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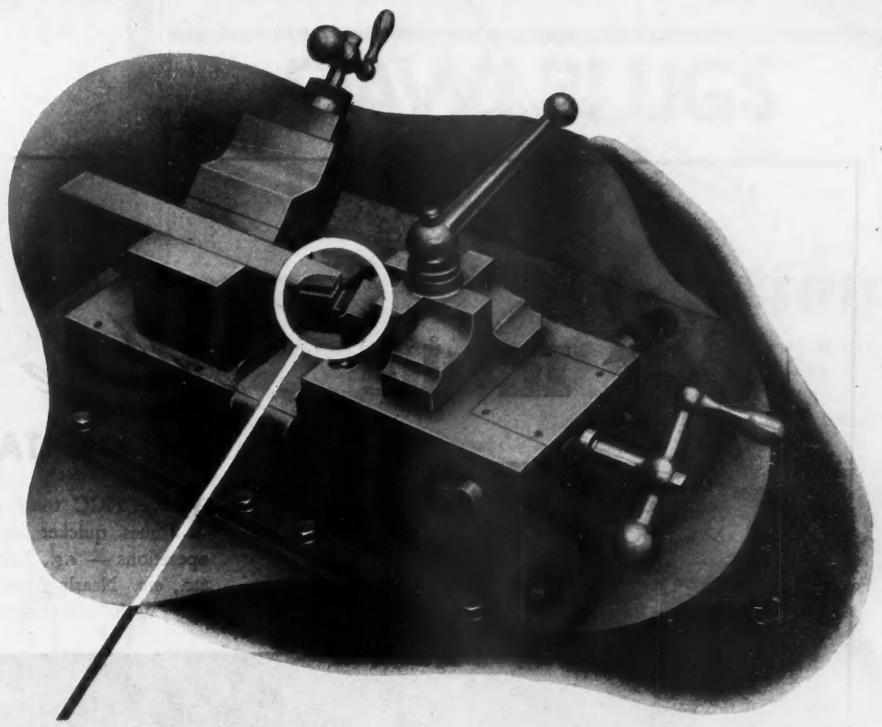

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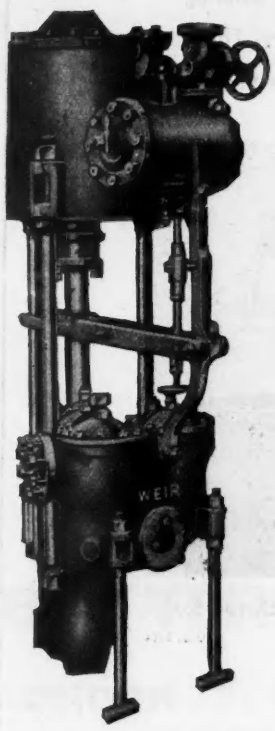

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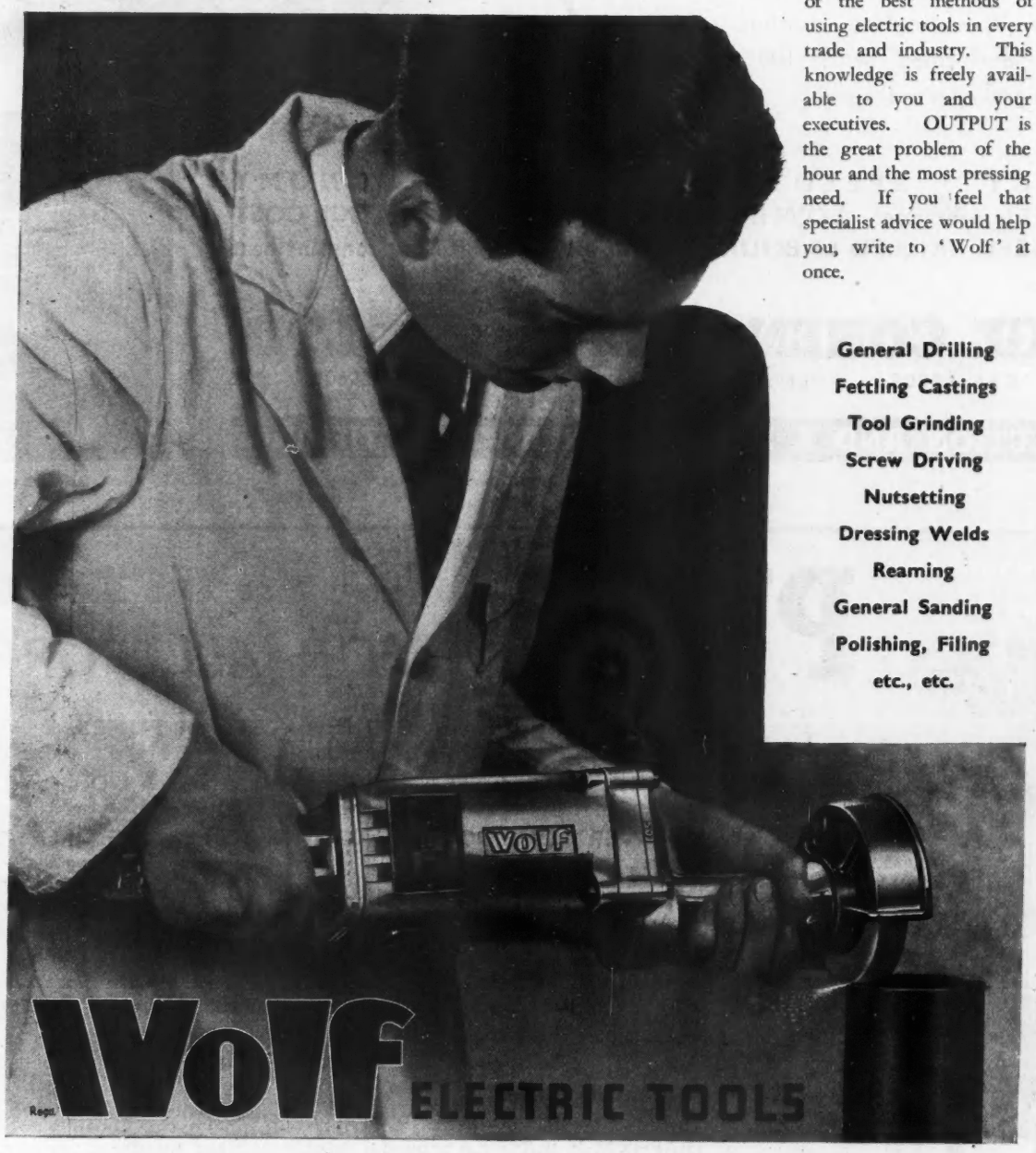

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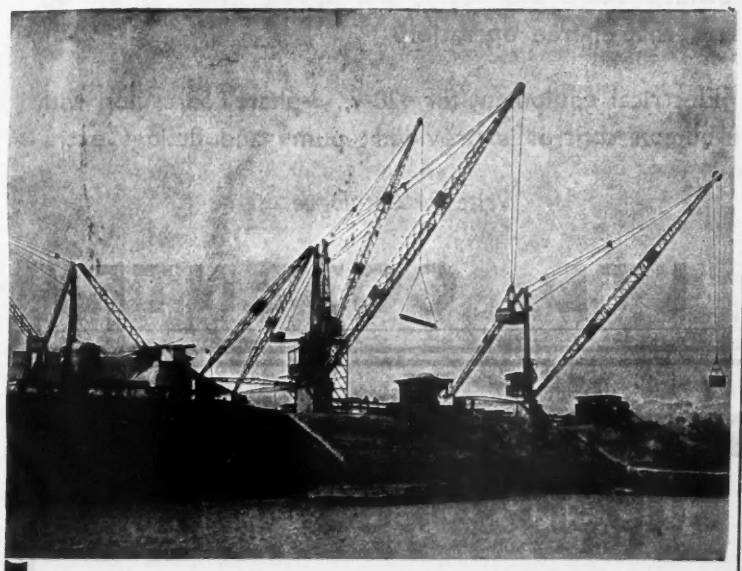

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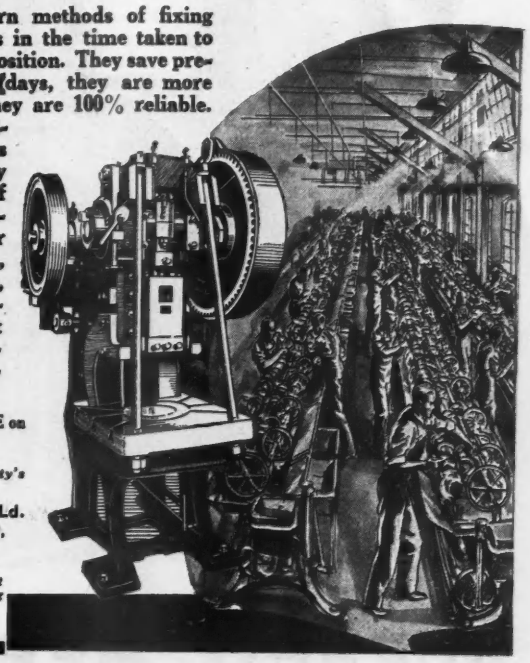

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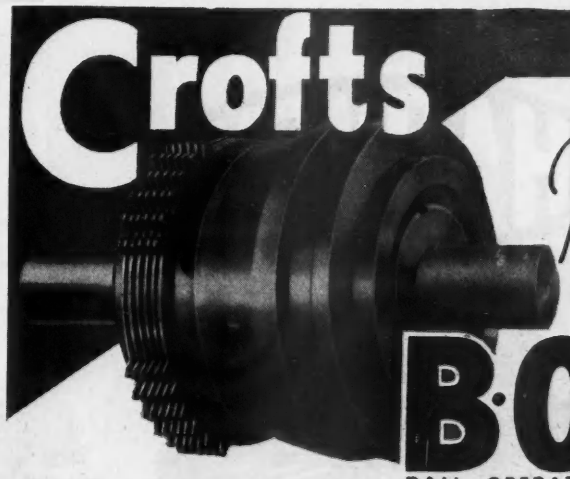

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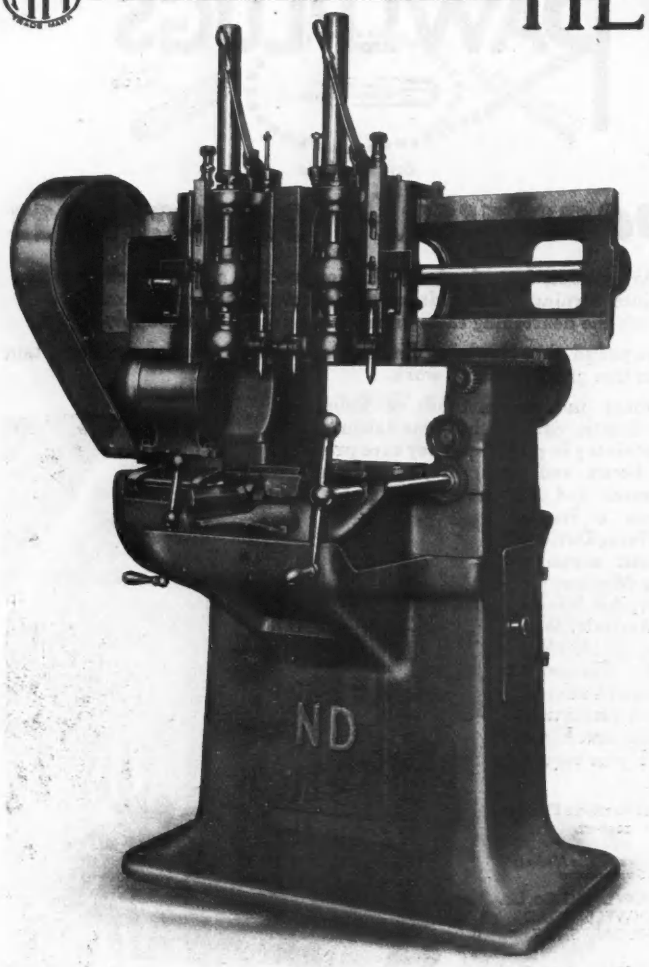

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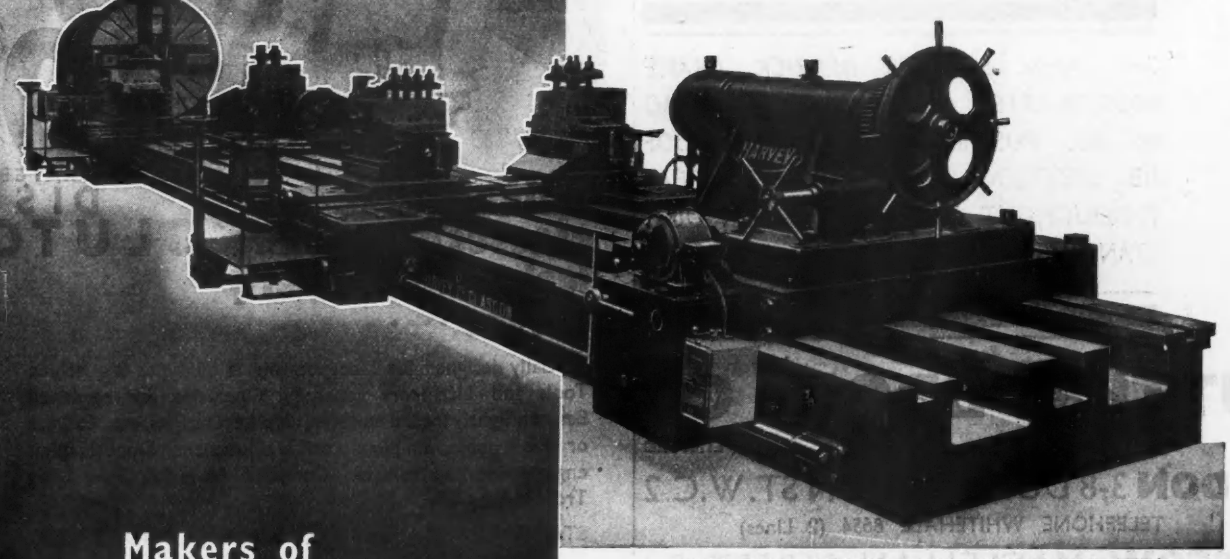

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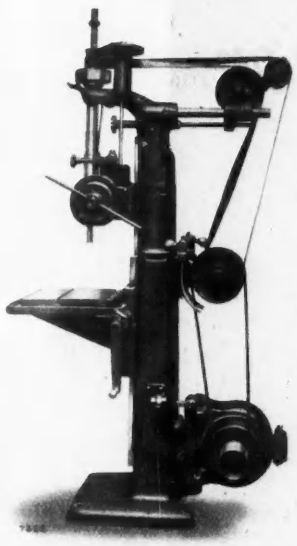

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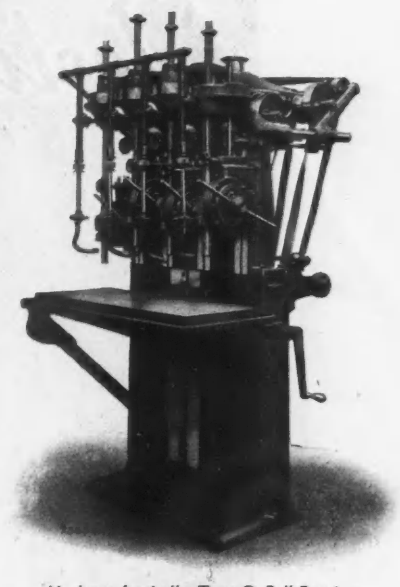

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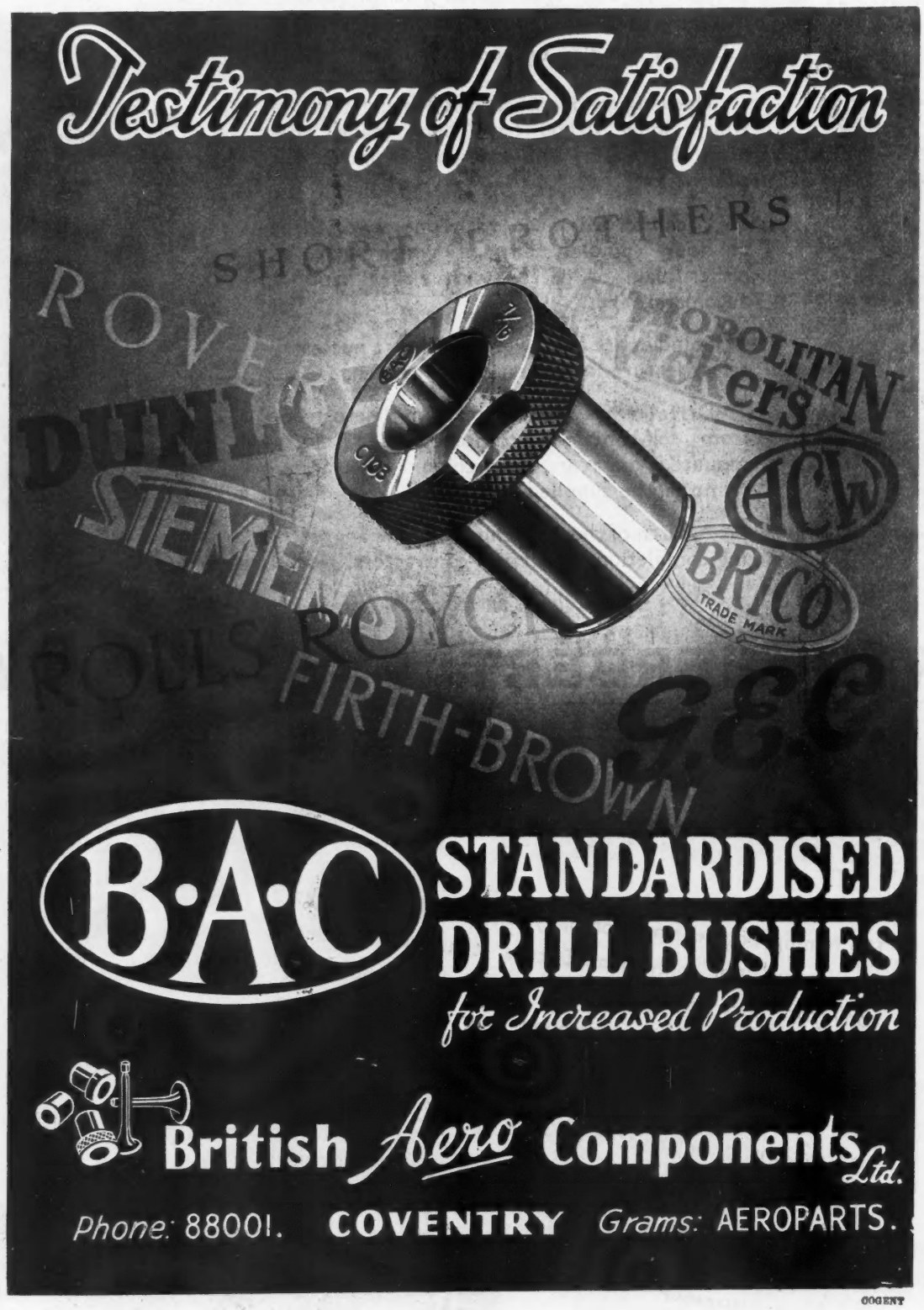
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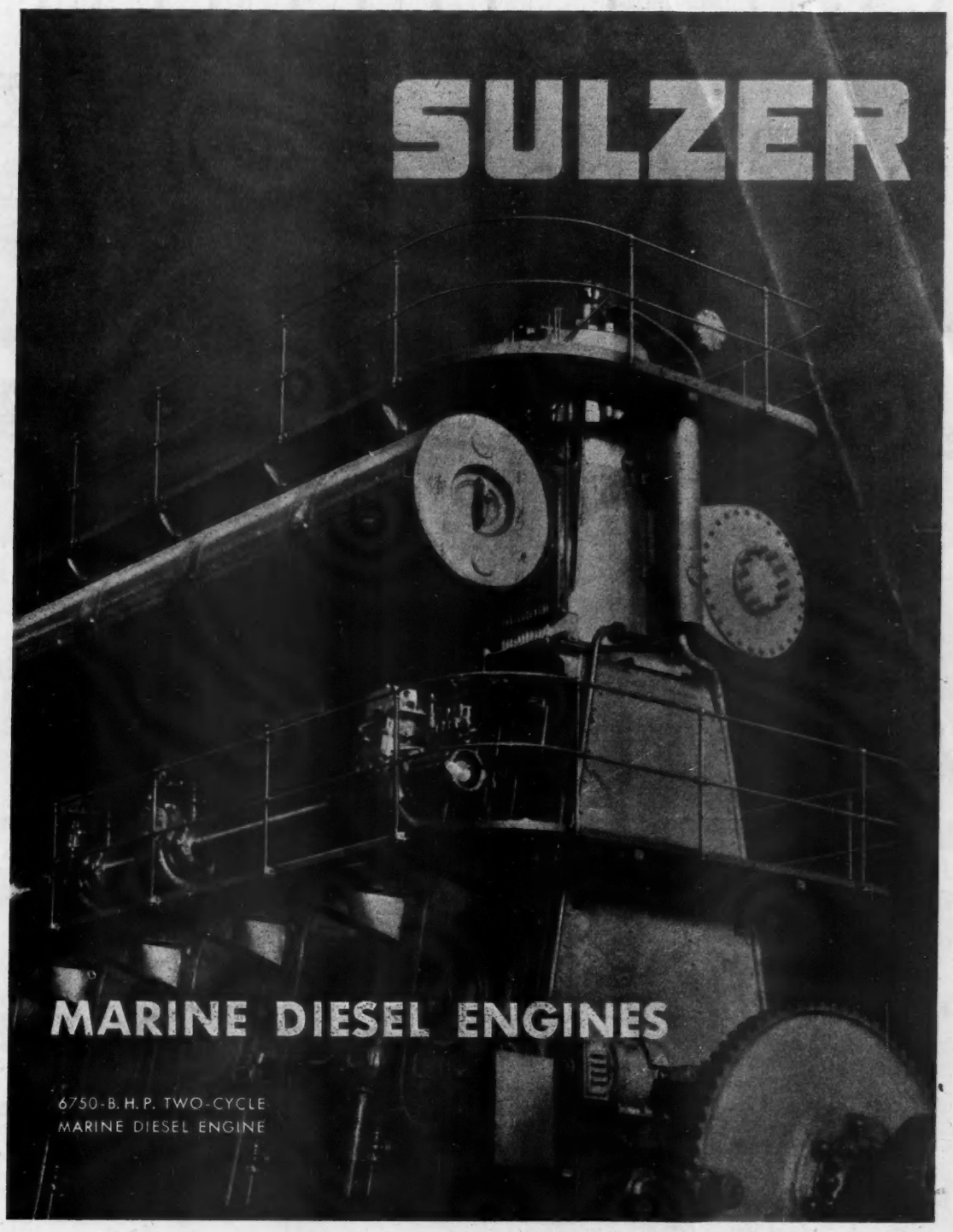

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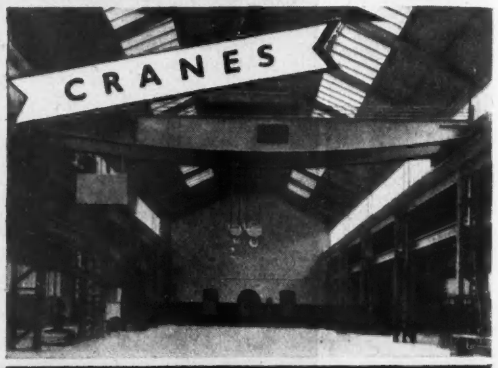

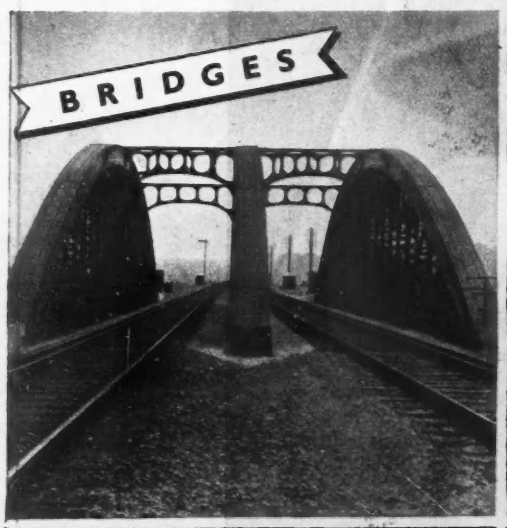

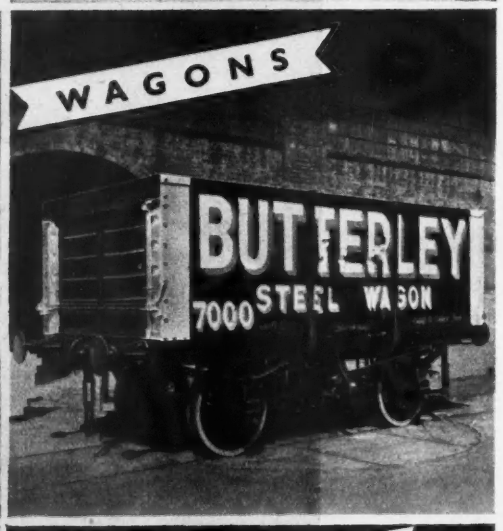

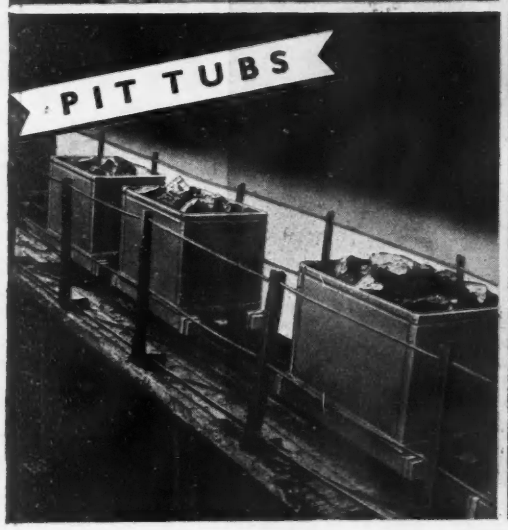

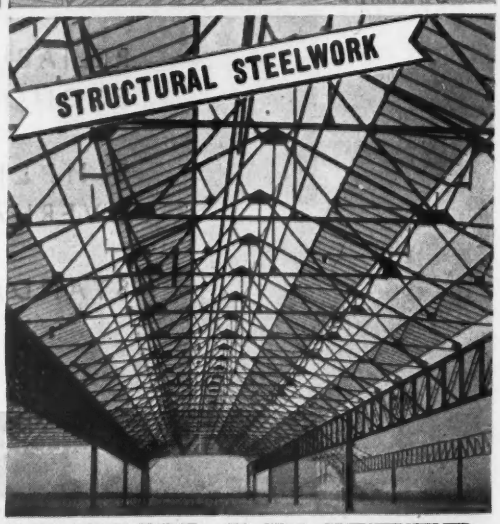

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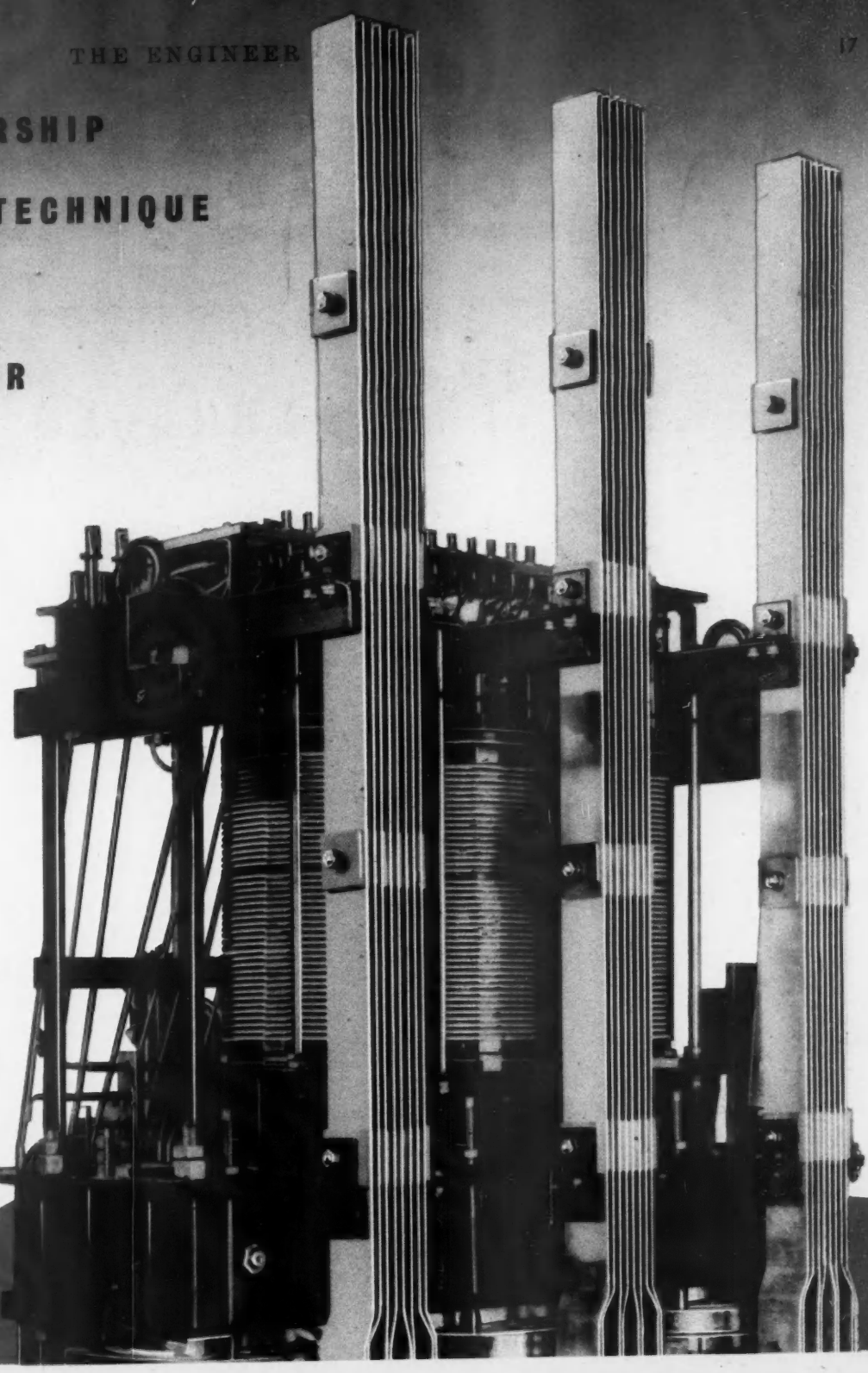

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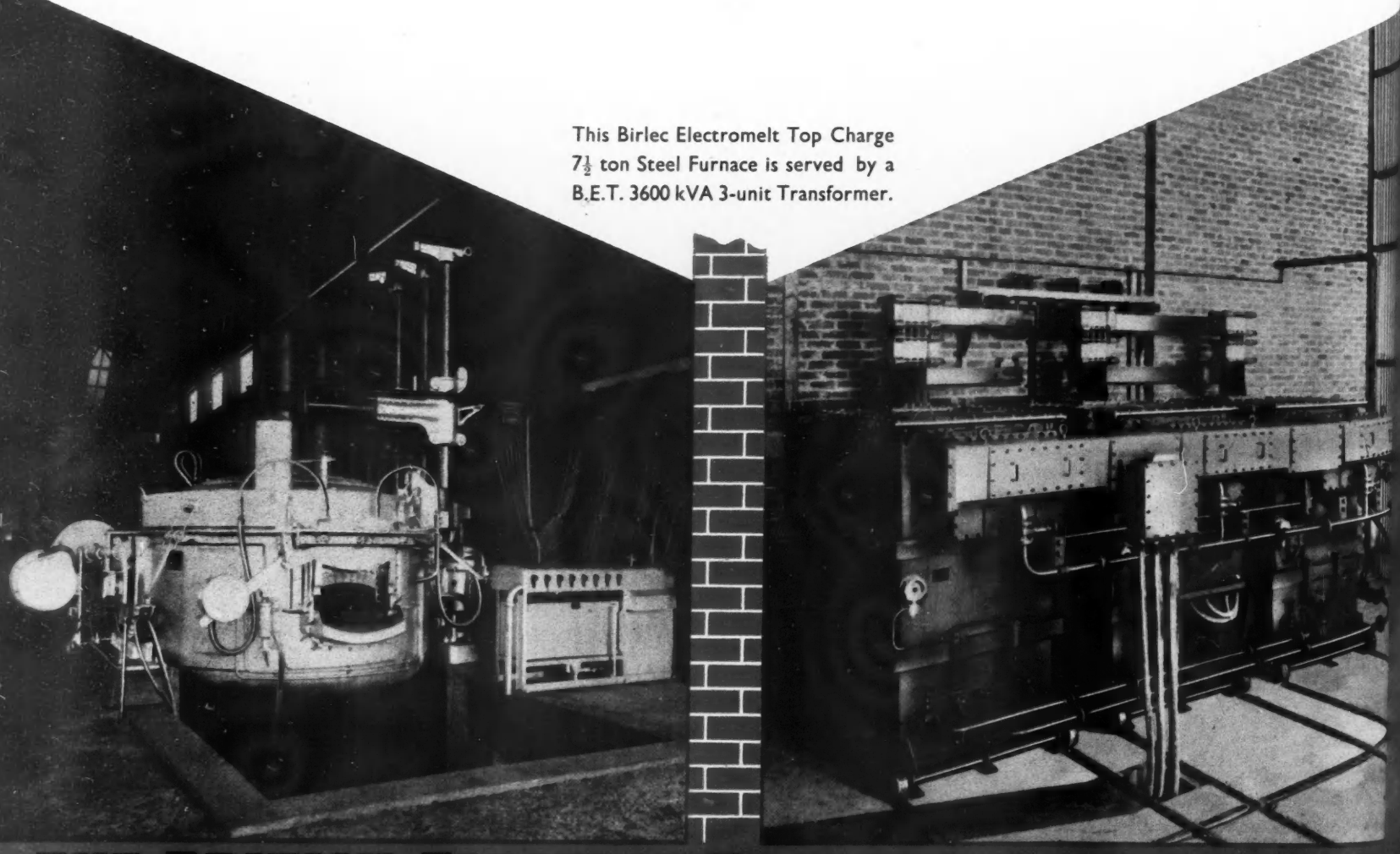

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(2) All orders placed for small Tools should have the following added:—"To be sent via Macrome Ltd., D. Dept., Alcester, Warwickshire, for Macrome treatment." A separate order to cover the treatment should be sent to Macrome Ltd. stating from whom the tools will be sent. (Treatment charges will be invoiced direct to the user by Macrome Ltd.)

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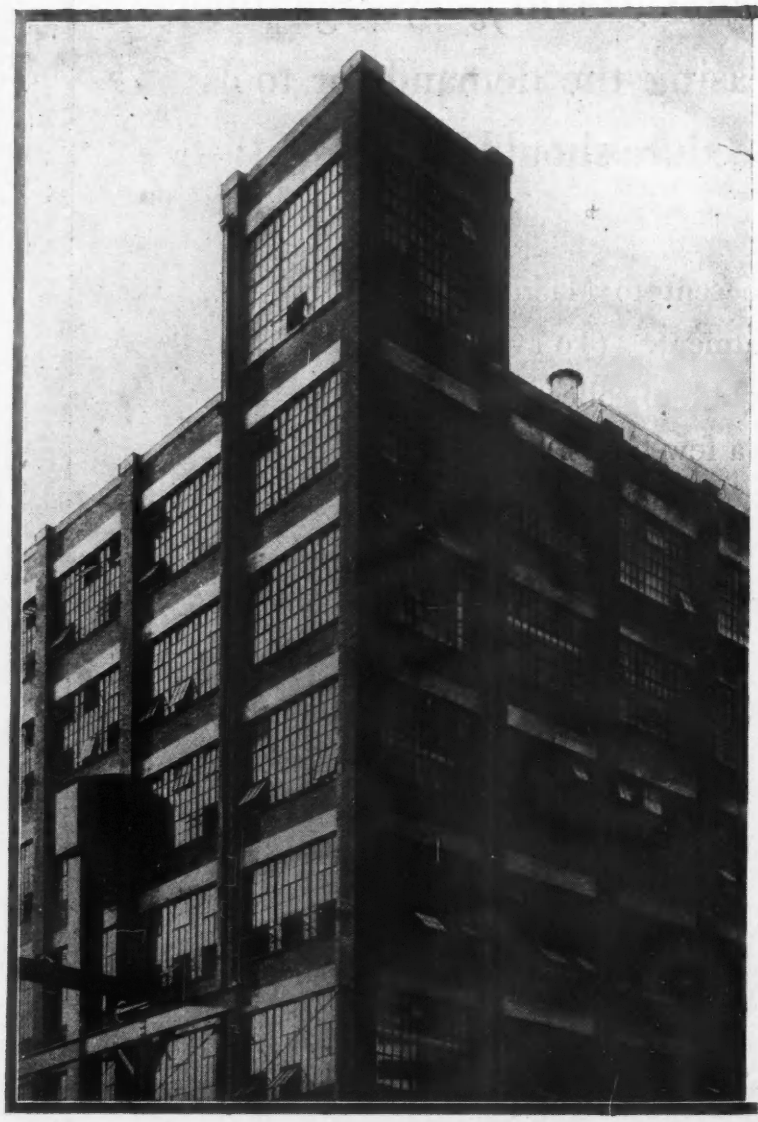

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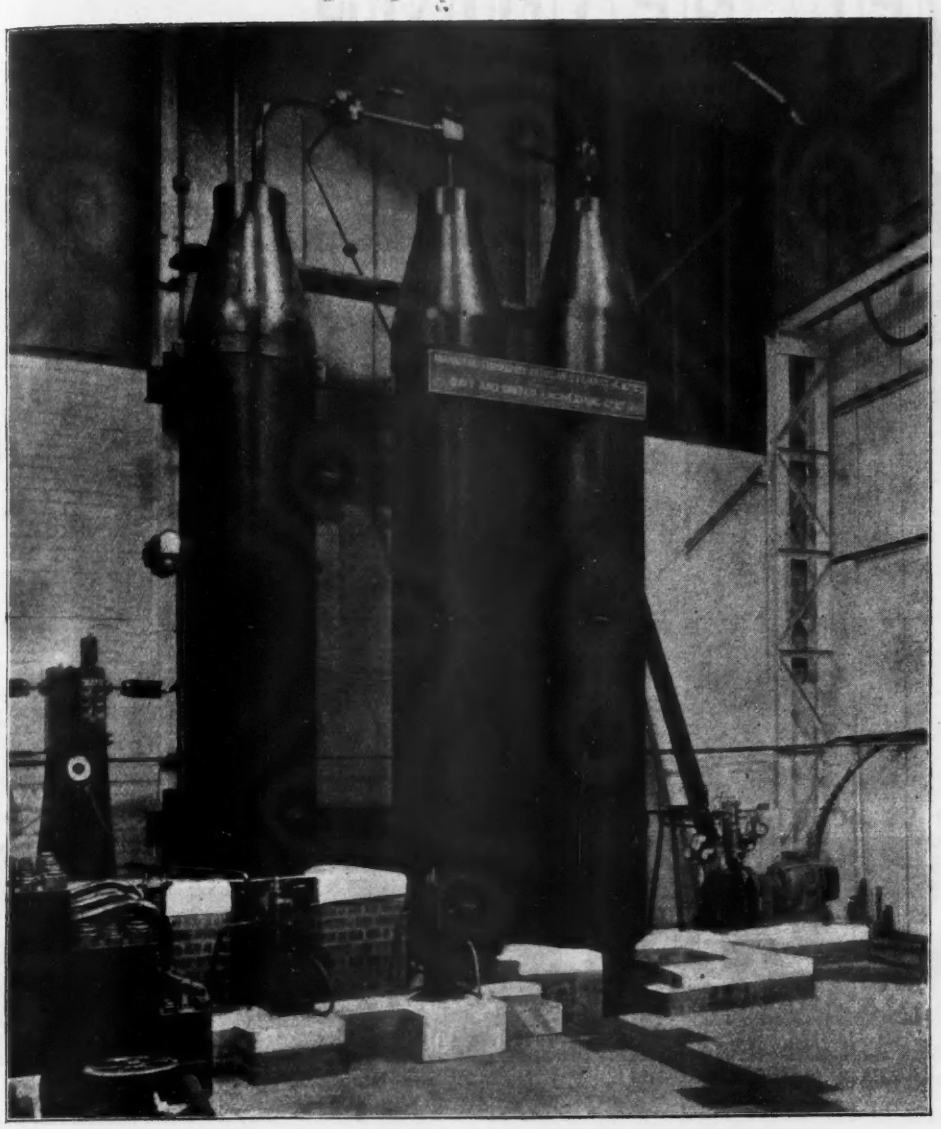

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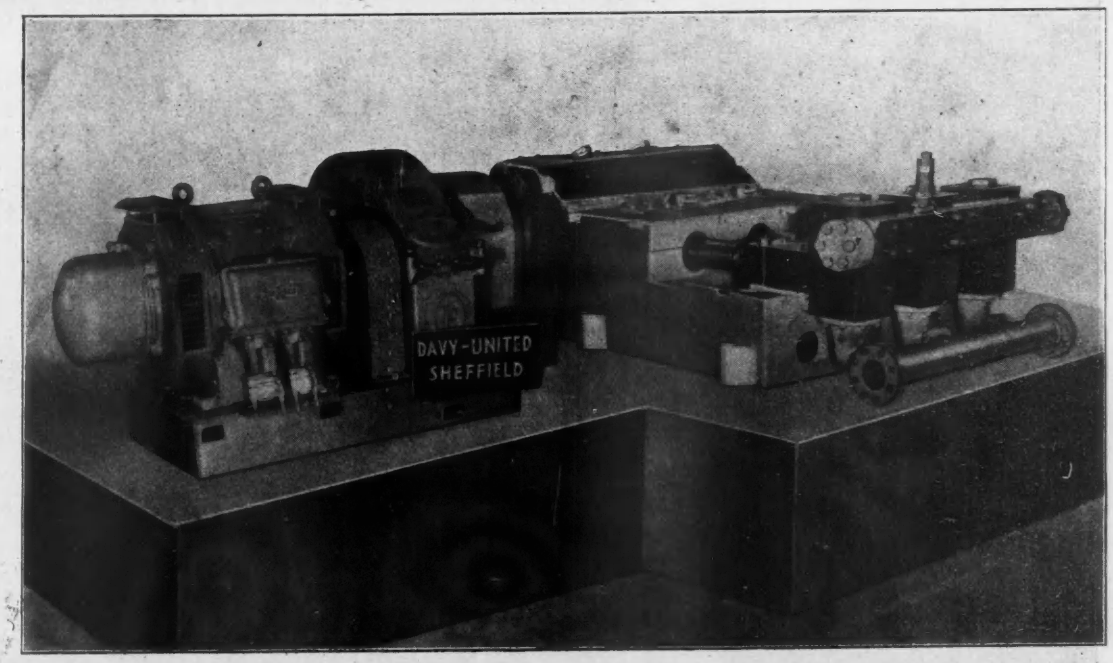

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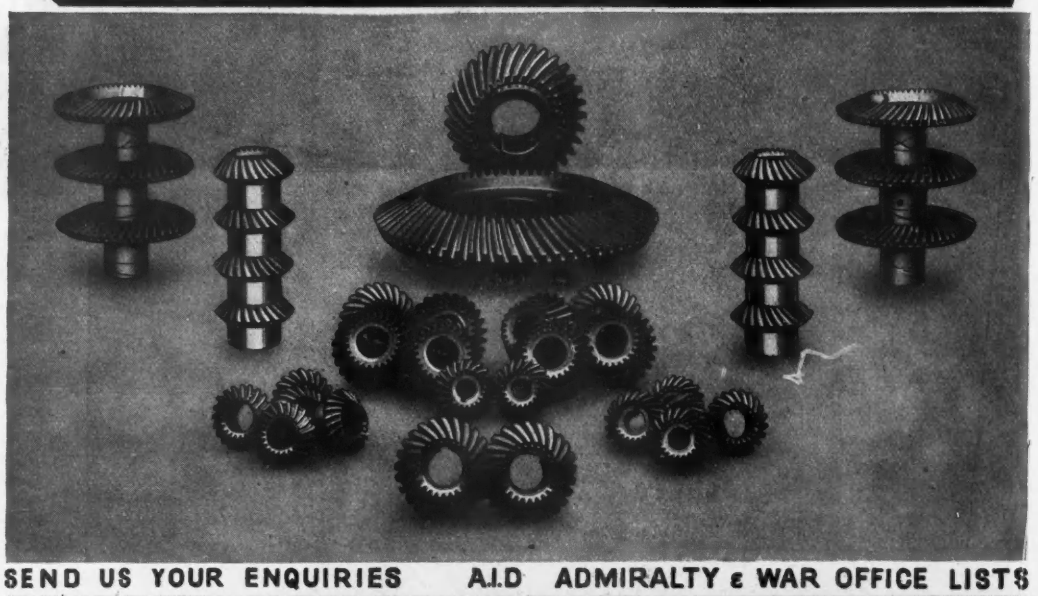

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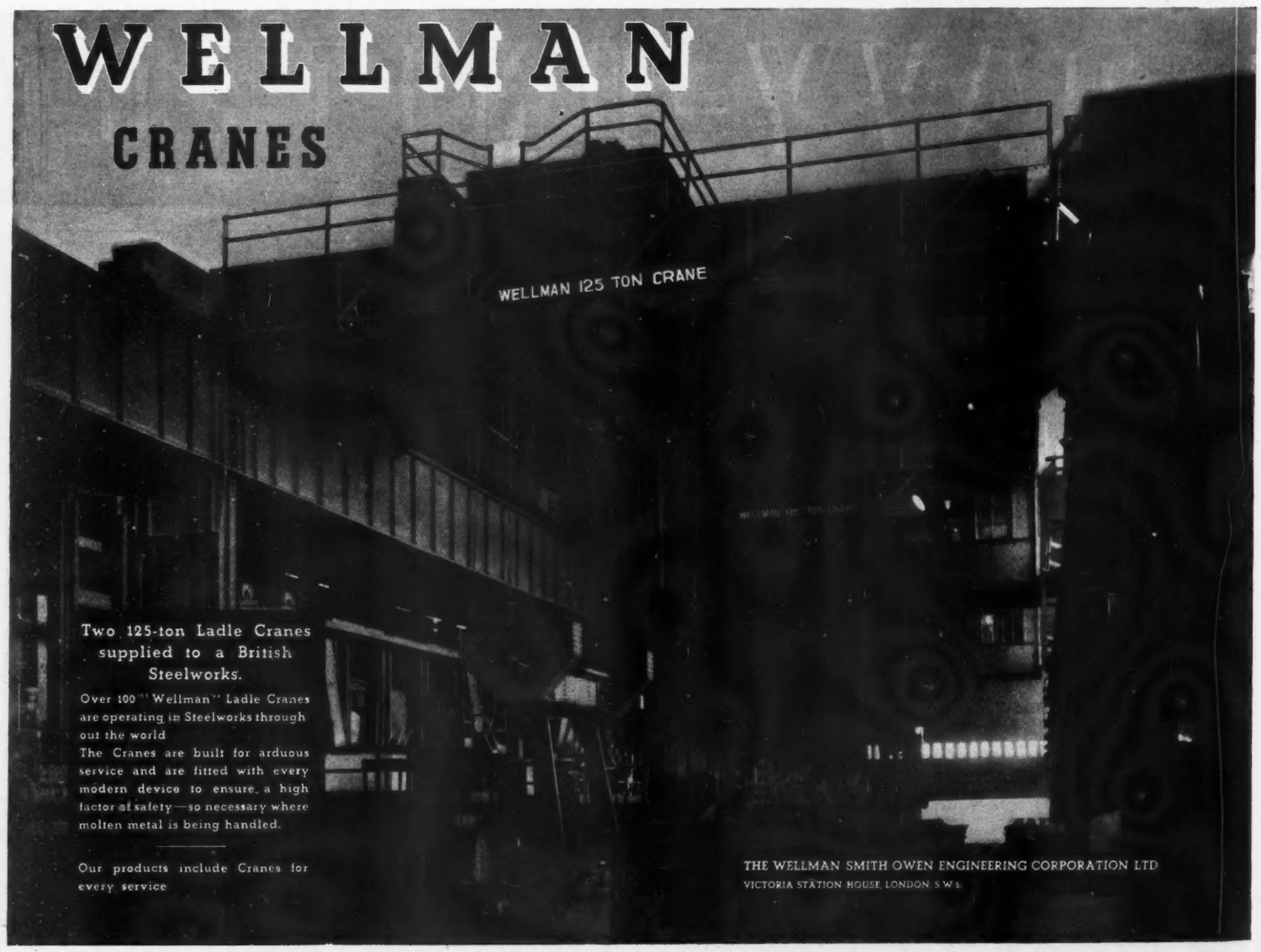

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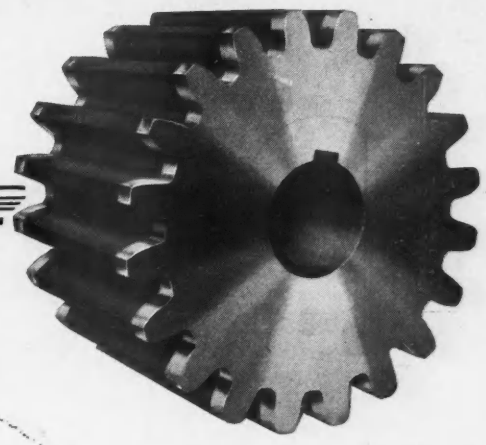

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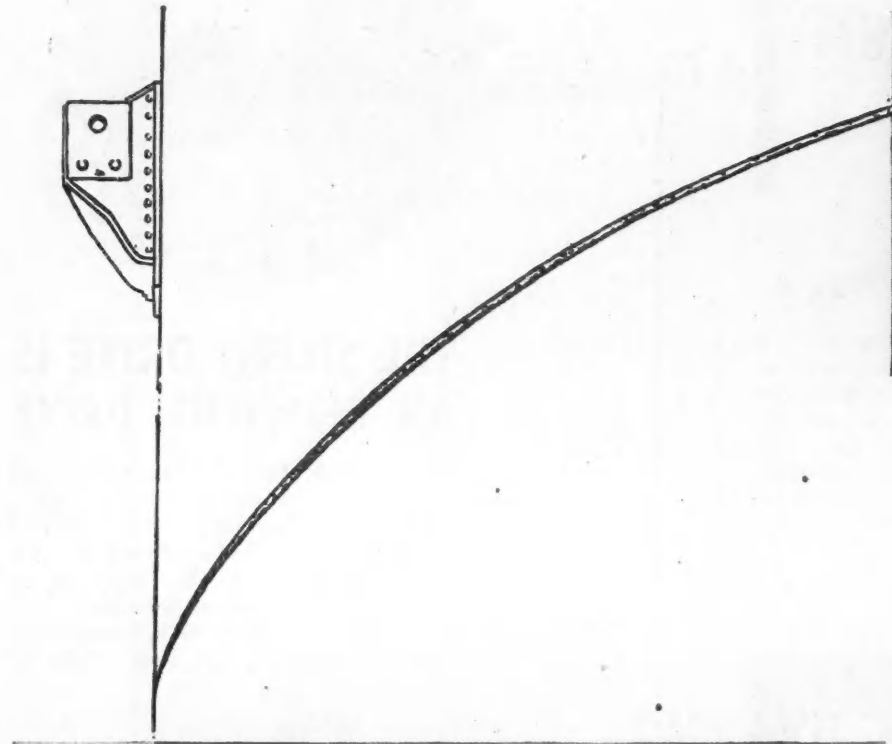

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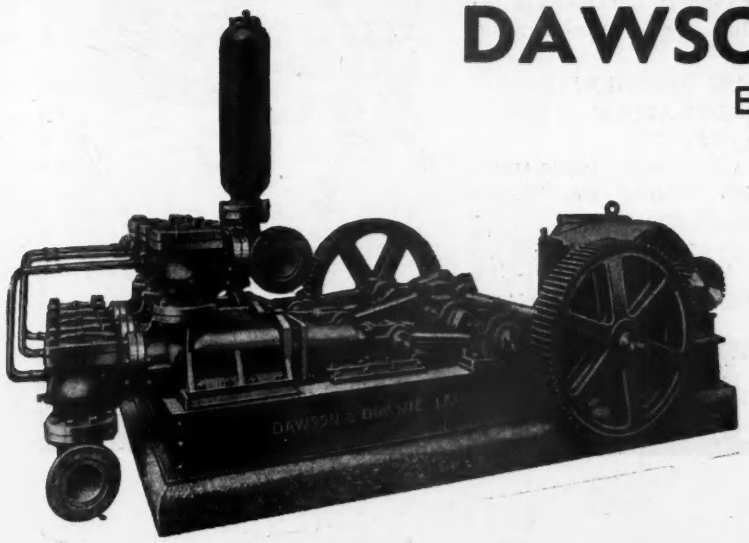

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For steam, water, oil and other pipe jointings.

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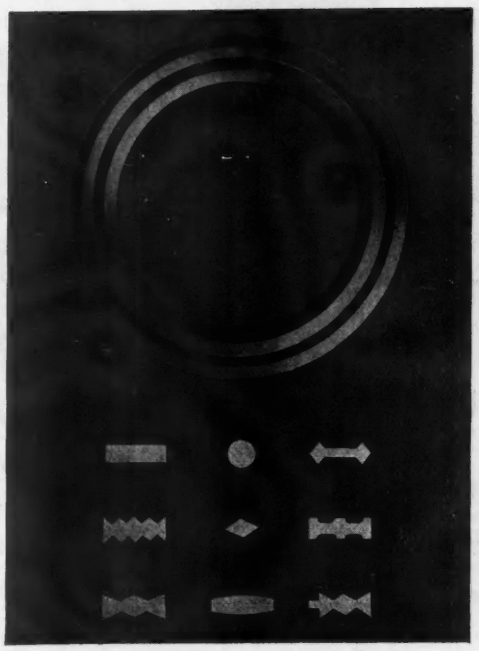

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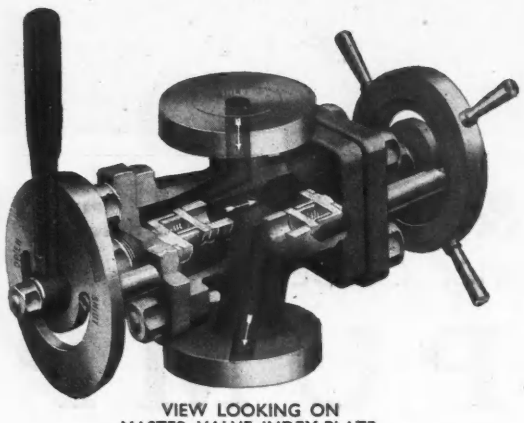

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Hopkinsons' Patent "Series-Uniflow" Valve is designed for exacting duties, e.g., high pressure drain service where the valve may be in the cracked position for long periods.

The interlocking device automatically ensures that the master valve is full-open before the regulating valve opens, and that the latter is completely closed before the master valve can be closed.

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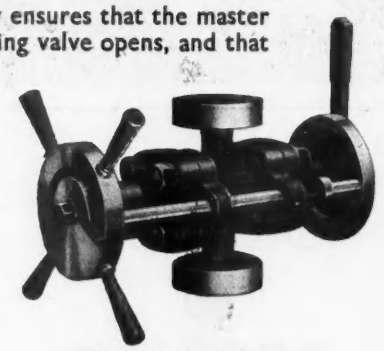

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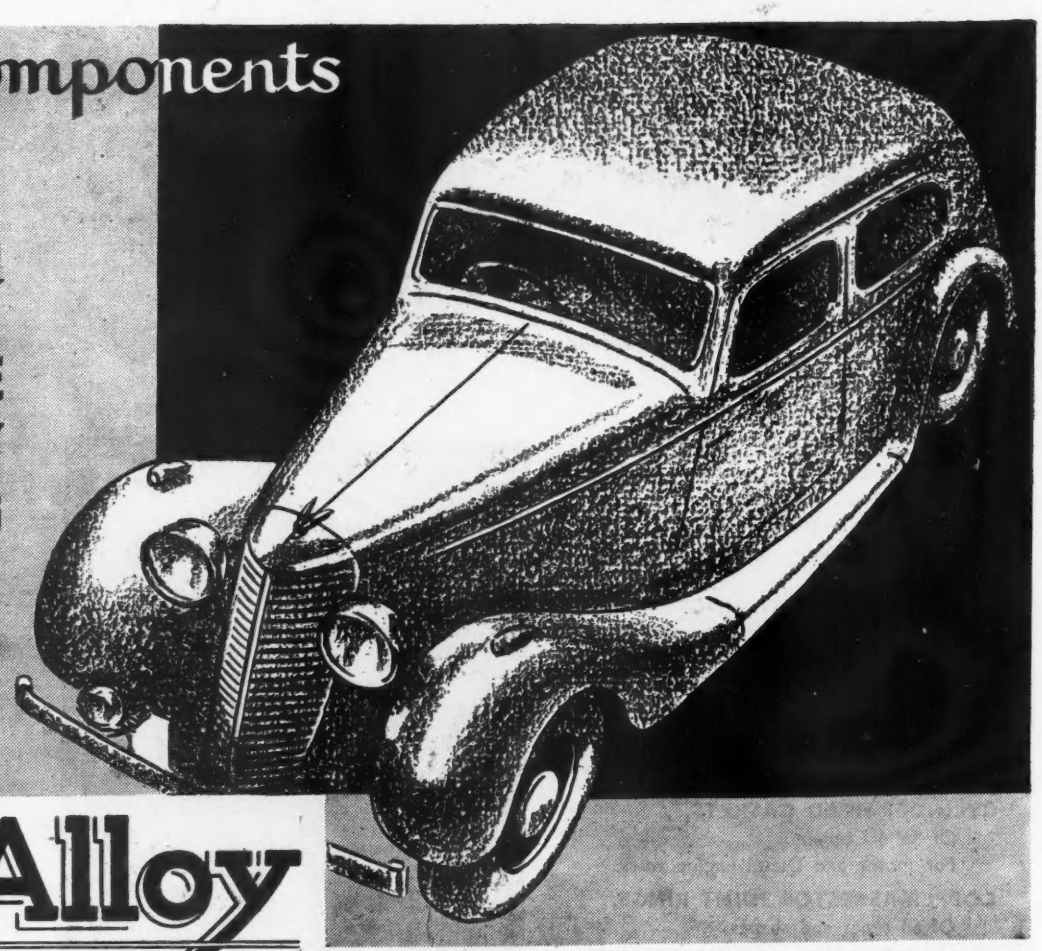

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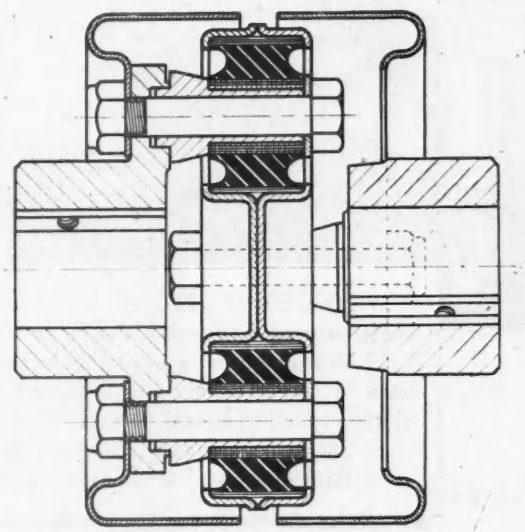
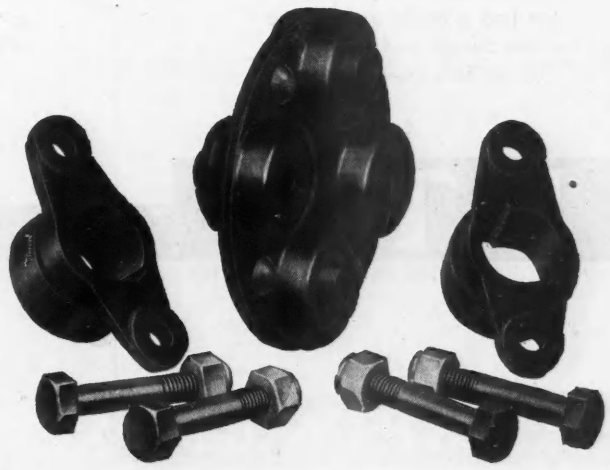
CONSTRUCTED from two forged steel hub-members fitted one to each shaft, between them is a floating centre which houses two pairs of resilient, reinforced, live noncold-flow Rubber Bushes set at 90°. These are securely assembled under pressure in the centre housing. The two hub-members are bolted tightly to opposite pairs of Rubber Bushes and the safety cover is held by the same bolts. Thus the Coupling becomes one Flexible Unit. Silentbloc Flexible Couplings are made to fit shafts of from $\frac{1}{4}$" to $3\frac{1}{2}$" diameter.



ASSEMBLED by the simplest of means, the two hub-members, the centre-housing and the safety cover are held by four bolts. The component parts are shown in the photograph. It is important that the bolts are fitted as tightly as possible, so that the Coupling becomes one Flexible Unit, permitting all flexing in the rubber bushes, and **eliminating entirely noise, wear, vibration and lubrication.**



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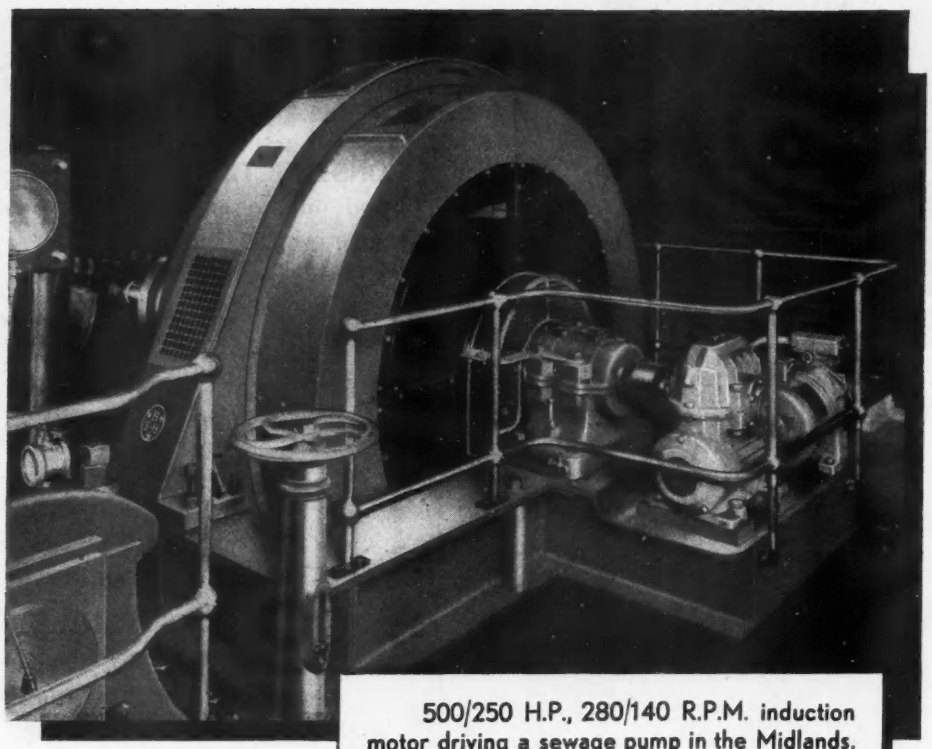

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Speed variation is obtained by means of a double-range Scherbius equipment.

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Riley Class "B" Automatic Stokers can be supplied as self-contained units or with a line shaft drive. The special design of the worm ensures an even distribution of the coal over the whole grate surface; the air passages are arranged to give a complete mingling of the coal and air at all ratings.

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NINETEEN WOBURN PLACE,
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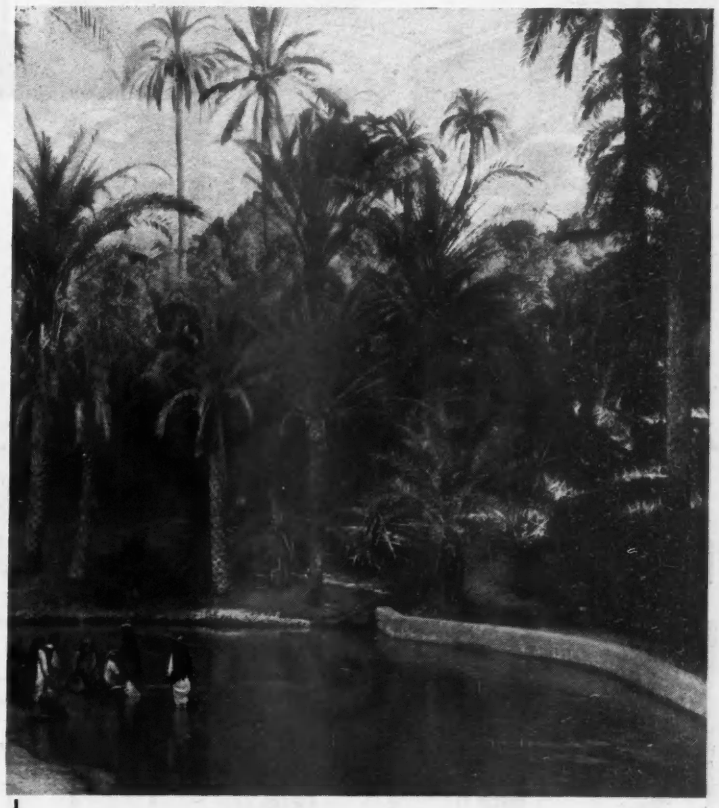

In the desert
– water is precious.

• • •

On board ships for drinking and for boiler feeding it is equally valuable.

WEIR EVAPORATING and DISTILLING PLANT.

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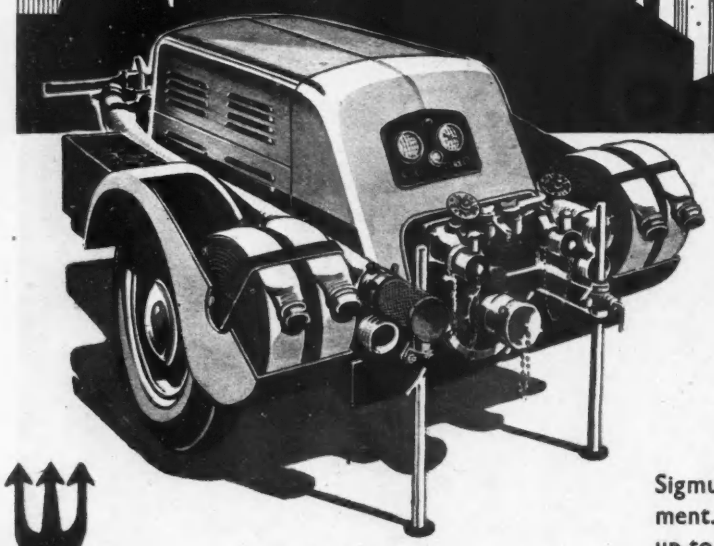

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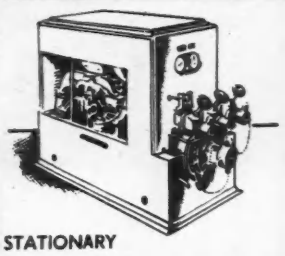
from 500 G.P.M. down to 50 G.P.M.

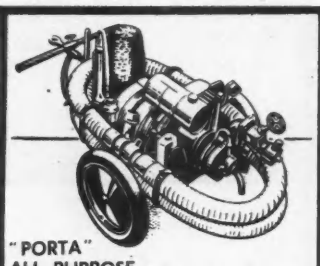
Britain's Industries must have the *BEST FIRE FIGHTING* protection

Adequate Fire Fighting Equipment is important at any time. To-day, when war conditions bring increased risks to industrial buildings, valuable plant and stock, it has become a vital necessity. Sigmund *specialise* in the manufacture of Fire Fighting Pumps and Equipment. Manufactured in a factory comprising the most modern and up-to-date plant, the Sigmund Range covers every possible requirement for Factories, Municipalities, etc.

A COMPLETE RANGE FOR EVERY NEED



STATIONARY



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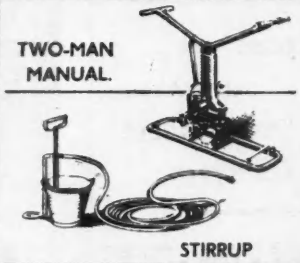
ALL PURPOSE.



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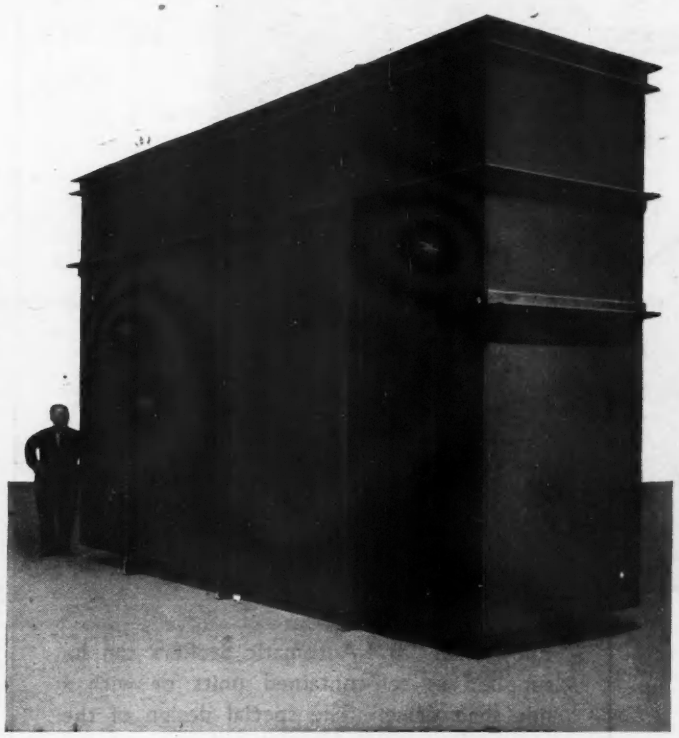

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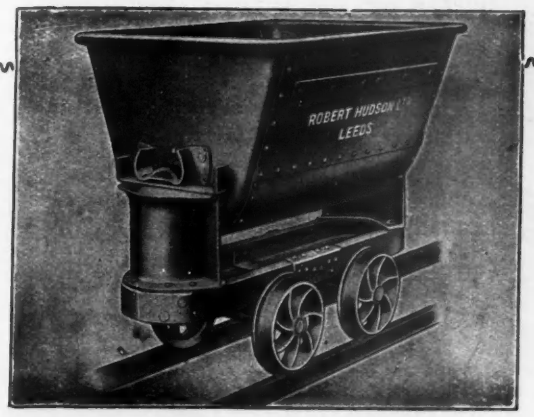

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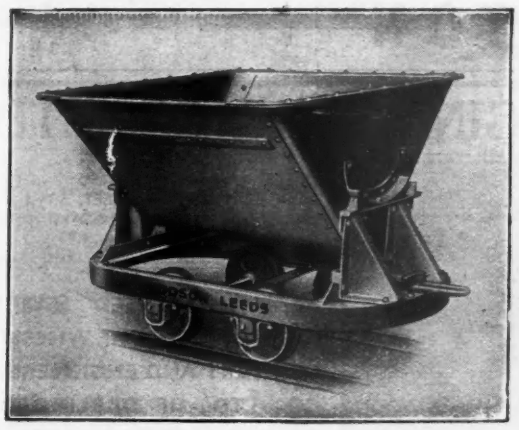

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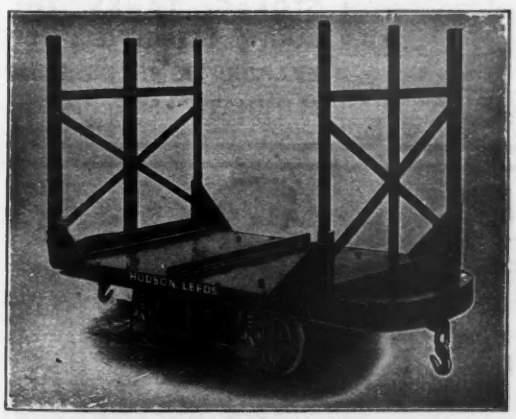

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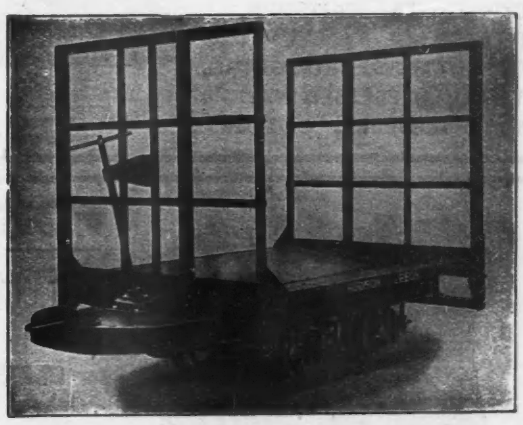

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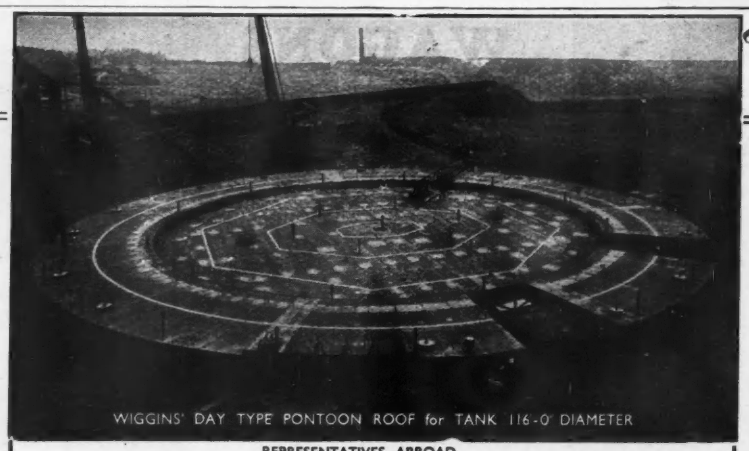

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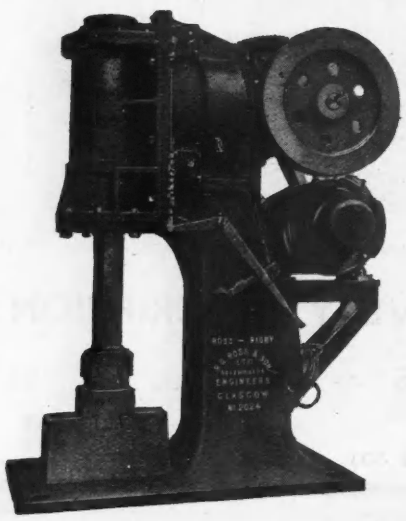

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Made in sizes up to 3 tons.

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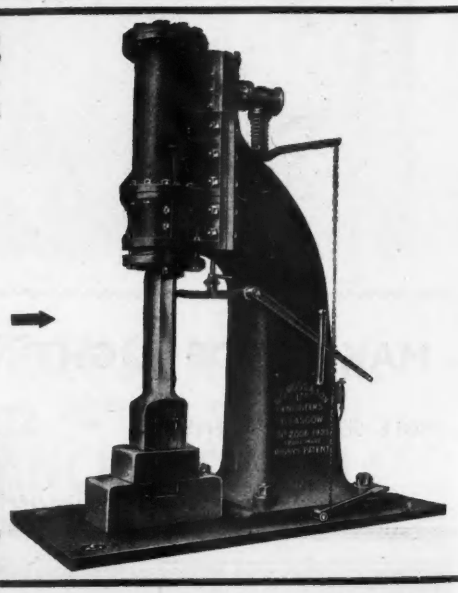

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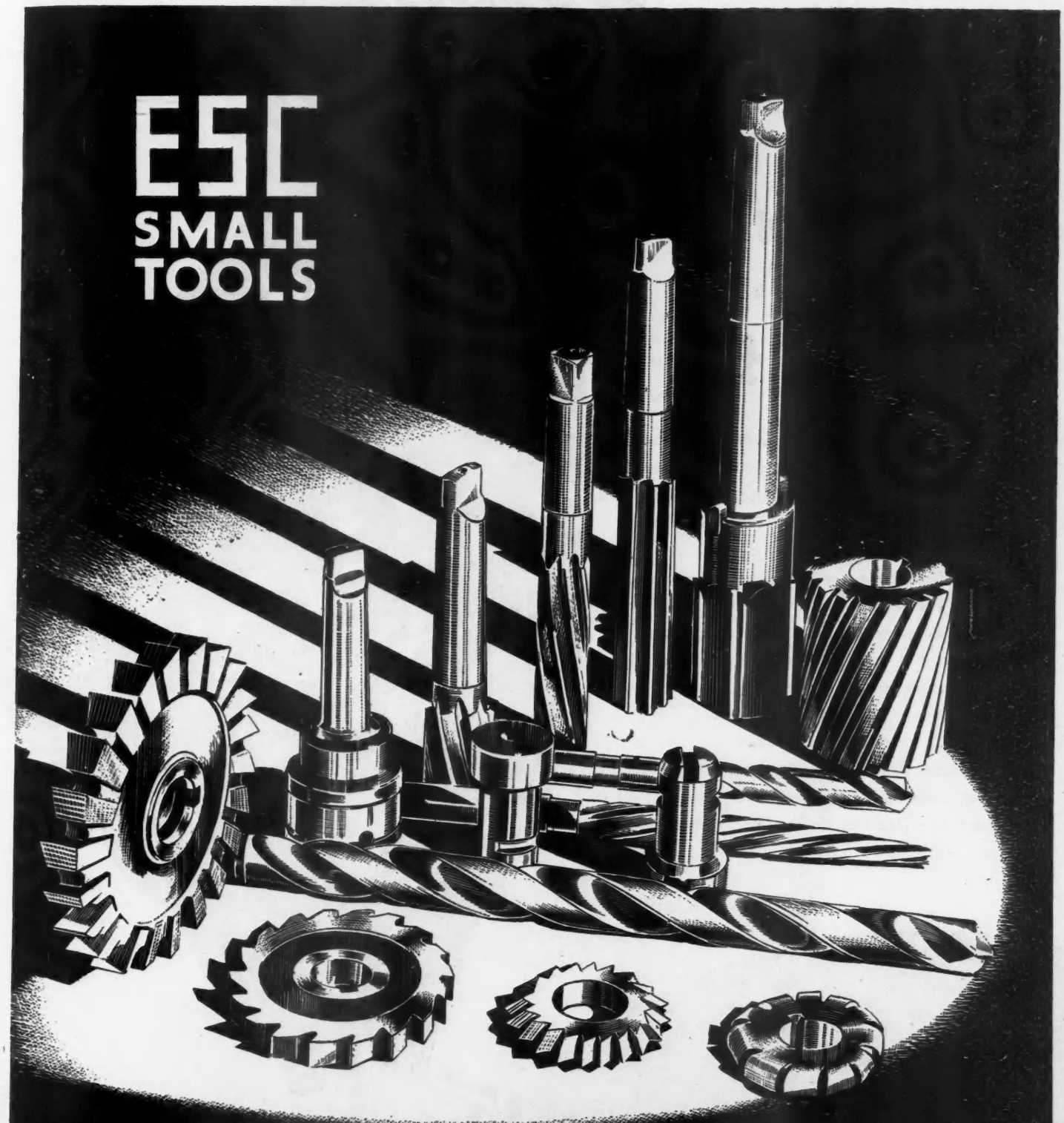

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A new word for a new world

As producers of electrically welded steel tubes, we took part in that silent pre-war revolution, when tubes, by reason of their lightness, strength and easy manipulation, rapidly became recognised as basic necessities in scores of industries as varied as ship-building, furnishing and cycle manufacture.

Now we look ahead. Without doubt, the tube will be a unit as vital as the brick or the beam in building the world that is to come. That is why we have decided to give an easily-remembered name to the electrically welded steel tubes made by Tube Products Limited.

TRU-WEL is the name that now stands for tubes of high concentricity, with a surface fine enough for decorative as well as structural purposes, tubes that can be supplied with the greatest speed and with the least human effort. TRU-WEL Tubes will be needed everywhere. They will be ready.

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N.S.24

ARE YOU SURE
your plant is
PROTECTED
against overloading?

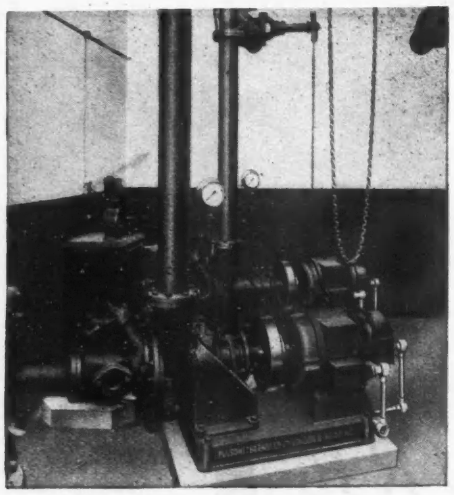
Machinery breakdowns must not occur. The enemy is thundering at the gates.

Flimsy and unreliable overload devices help the enemy by permitting small troubles to develop into serious breakdowns. Protect your plant then by using Ellison overload devices that operate with certainty when the load reaches as little as 10% above normal.

An Ellison Overload Relay can easily be connected in series with your present starting gear.

Ellison Auto-transformer starter controlling the motor of a refining machine in a Food Factory.

C25



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By cutting up **all suspended solids,** facilitates the subsequent handling of unscreened sewage, trade effluents, sludge, etc., and is particularly useful in preventing nuisance on the foreshore near a sewage outfall ; when mains are long and the velocity of the flow of water is low ; for sewage to be treated in digesting tanks, and, in the larger sizes, for crude sewage sludge.

Illustrated is a Stereophagus installation supplied to the Reading Corporation.

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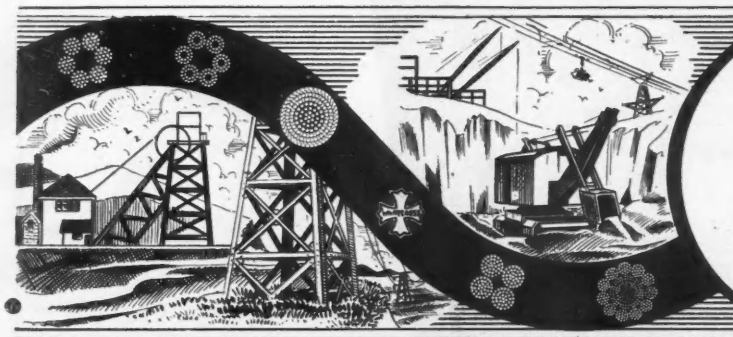

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Engineers in every branch of Industry know they can rely upon Whitecross service in Steel Wire Ropes.

Many have proved for themselves the value of the expert advice and extensive manufacturing facilities which Whitecross can offer.

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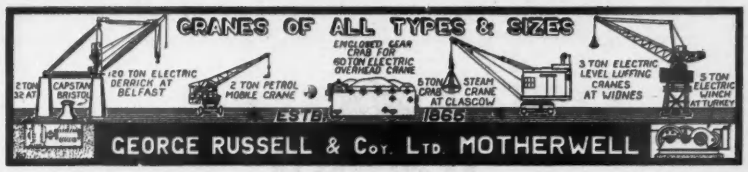
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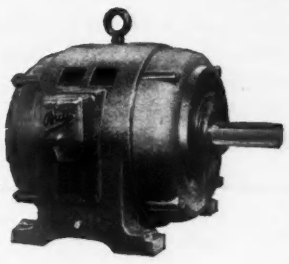

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★ As one of the most important men in Britain to-day, the highly skilled craftsman demands unfailing service from his tools and plant. It is for this reason that BULL MOTORS feature so prominently in specifications, and that our new factory is working to the utmost of its capacity to meet orders of vital National importance. For such work the majority of industrial type models are available from stock.

To avoid delay it is essential that we receive appropriate Steel Authorisation at the time of order.

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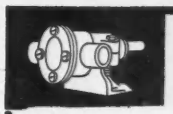

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3½"
4"
6"
10"
and still larger sizes

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Plunger Pumps *with* **Rotary Motion**

Capacities 8 to 50,000 G.P.H. Heads up to 150 ft. Suction 25" without priming.

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Flow same direction with change of rotation.

Conversely flow may be reversed without change of direction

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USED BY GOVERNMENT DEPARTMENTS AND ALL LEADING QUARRY OWNERS AND CONTRACTORS

TRAINING SCHEMES MUST BE DEVELOPED TO THE MAXIMUM EXTENT

"Take in more new workers for training on the job in your own works. Remember that the Government will help you with semi-skilled men and women trained under official schemes."

(This is Point No. 2 of the Ministry of Labour's "4-POINT PLAN TO INCREASE WAR PRODUCTION" addressed to management.)

THE OTHER 3 POINTS IN THE PLAN ARE:—

POINT No. 1. Skilled men are needed for the really skilled jobs. Be sure that each of your men is employed up to the very limit of his skill. Combat skilled labour shortage by breaking down processes wherever you can, and by training up your workpeople, both men and women, to jobs of greater skill.

POINT No. 3. Prepare, now, to employ more and more women. Look constantly to women for your new recruits; they are excellently suited to many types of semi-skilled work. Hundreds of thousands must enter war production this year and every factory must play its part.

POINT No. 4. Efficient personnel management is essential. Remember that you must secure the whole-hearted co-operation of your workpeople. Look closely to their welfare. Many of them may be new to industry; be patient and help them all you can during the first difficult weeks. A little foresight will reduce your labour turnover.

ADVICE GLADLY GIVEN ON THE DEVELOPMENT OF A TRAINING SCHEME IN YOUR WORKS.

If you feel you would like advice on the development of training in your works, remember that the Labour Supply Inspectors of the Ministry of Labour and National Service are ready and anxious to assist you. You can reach them through the Manager of your Local Employment Exchange. You can obtain full particulars of the Government Training Schemes from the Inspectors or from the Exchange.

REMEMBER! if you have not yet received your copy of "THE EMPLOYMENT OF WOMEN . . . SUGGESTIONS TO EMPLOYERS" instruct your secretary to write for one to-day, asking for pamphlet 87/1941 to the Manager of the nearest office of the Ministry of Labour and National Service.

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Total generating capacity when completed 424,000 K.W.

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Operating steam conditions 355 lbs. per square inch, 761° F.

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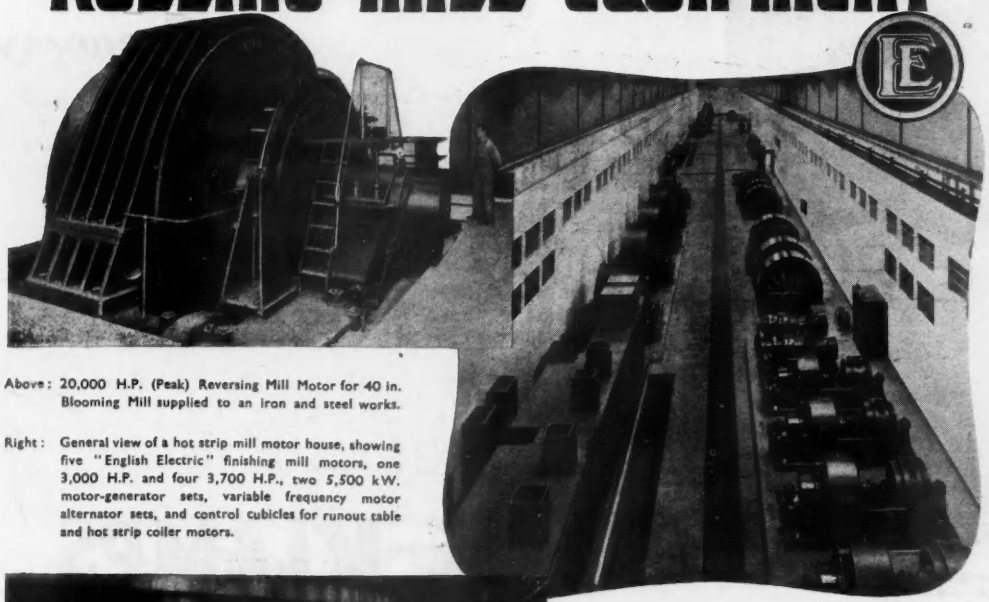
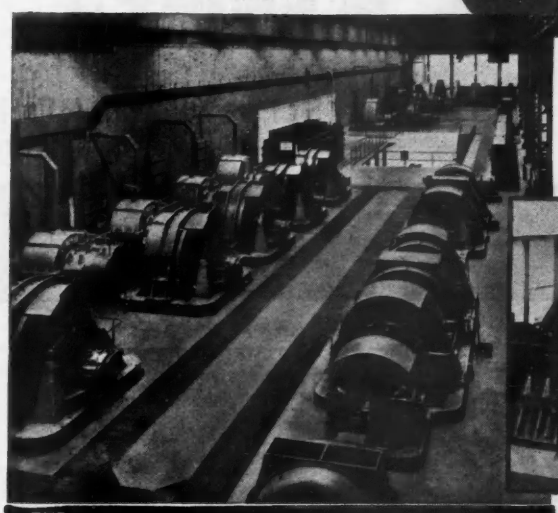


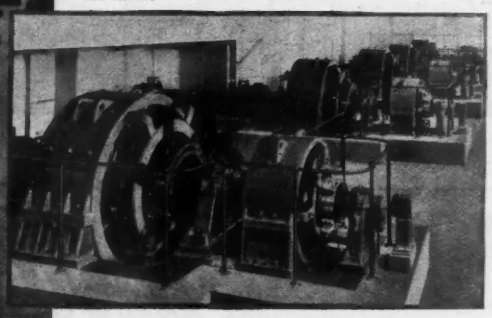
Above: 20,000 H.P. (Peak) Reversing Mill Motor for 40 in. Blooming Mill supplied to an iron and steel works.

Right: General view of a hot strip mill motor house, showing five "English Electric" finishing mill motors, one 3,000 H.P. and four 3,700 H.P., two 5,500 kW. motor-generator sets, variable frequency motor alternator sets, and control cubicles for runout table and hot strip coiler motors.



Left: Motor room of a hot wide strip mill, showing the main roughing and finishing mill drives, and motor-generator sets at a large steel works.

Lower: Morgan narrow strip mill motor room, showing 750 H.P. motors with direct-coupled generators of 120 kW. capacity feeding "edger" motors, at another large steel works.



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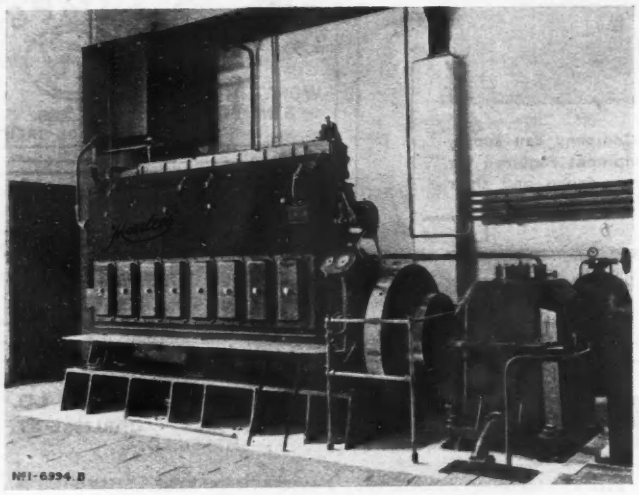

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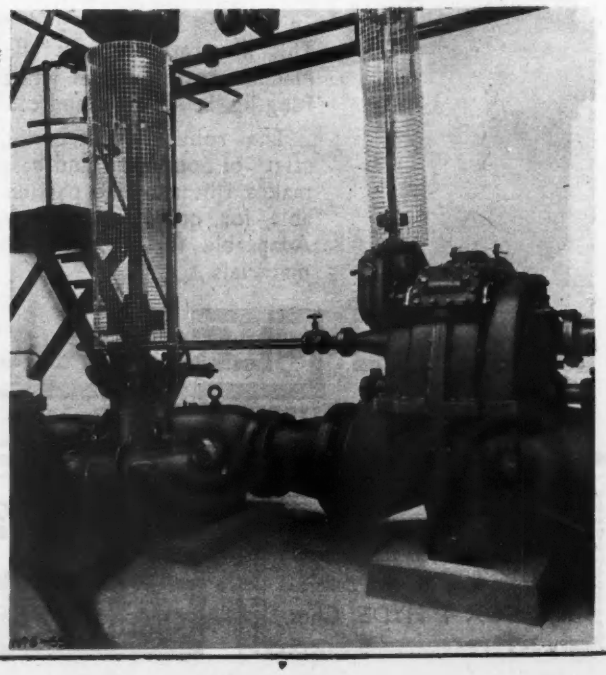

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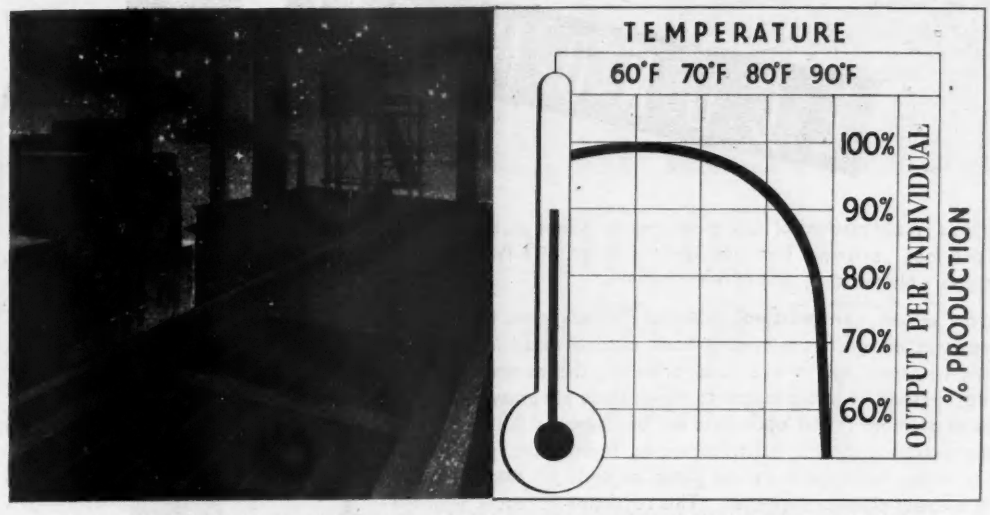

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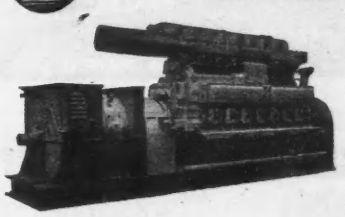

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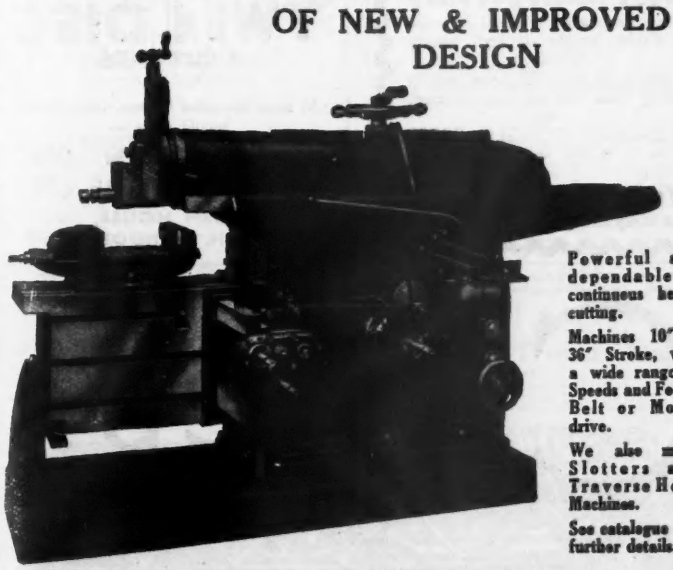

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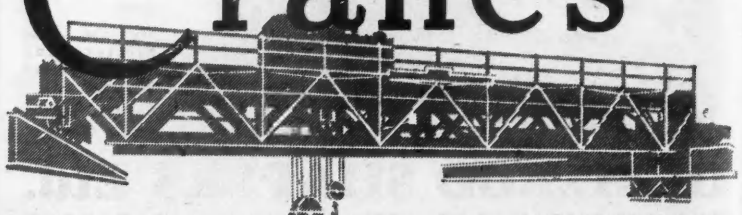

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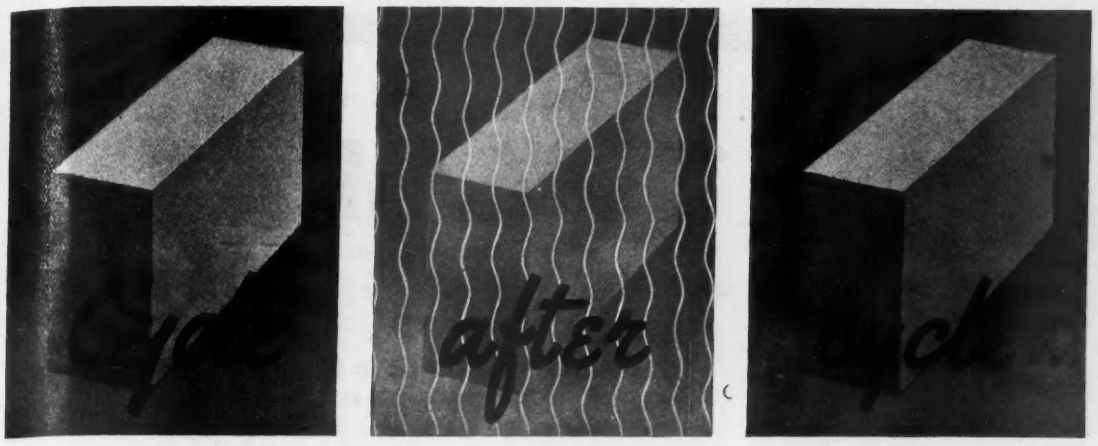

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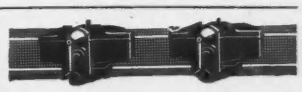
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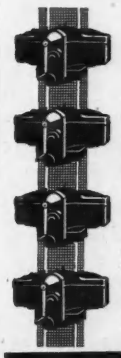
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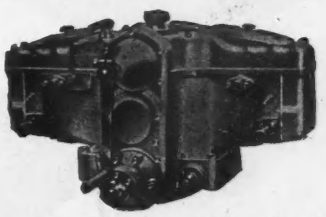
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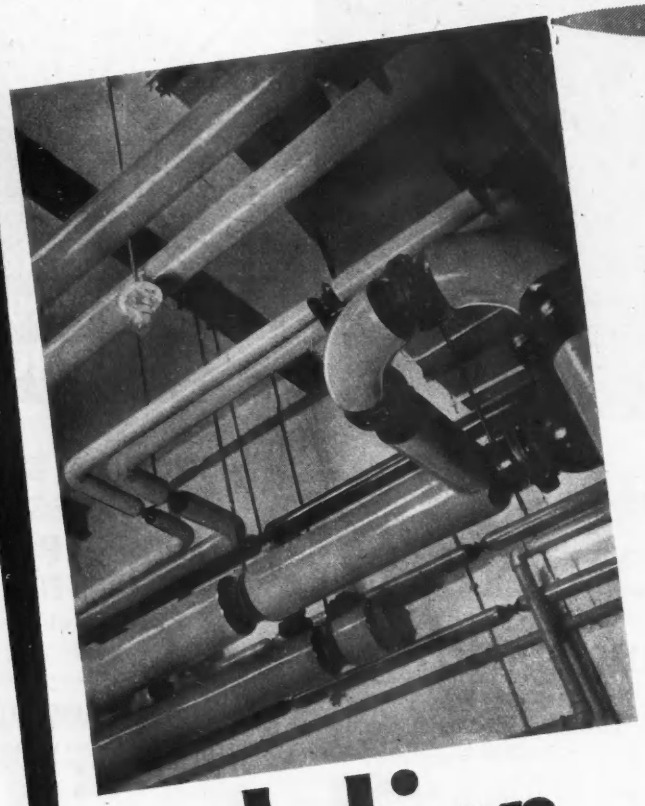

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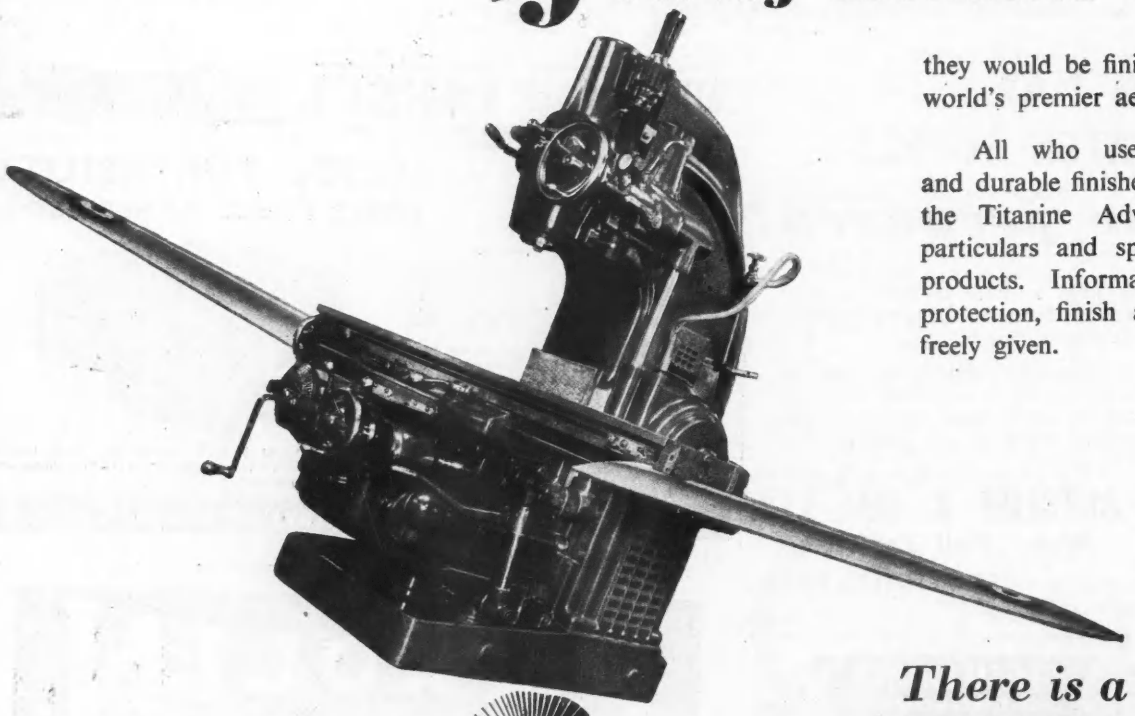

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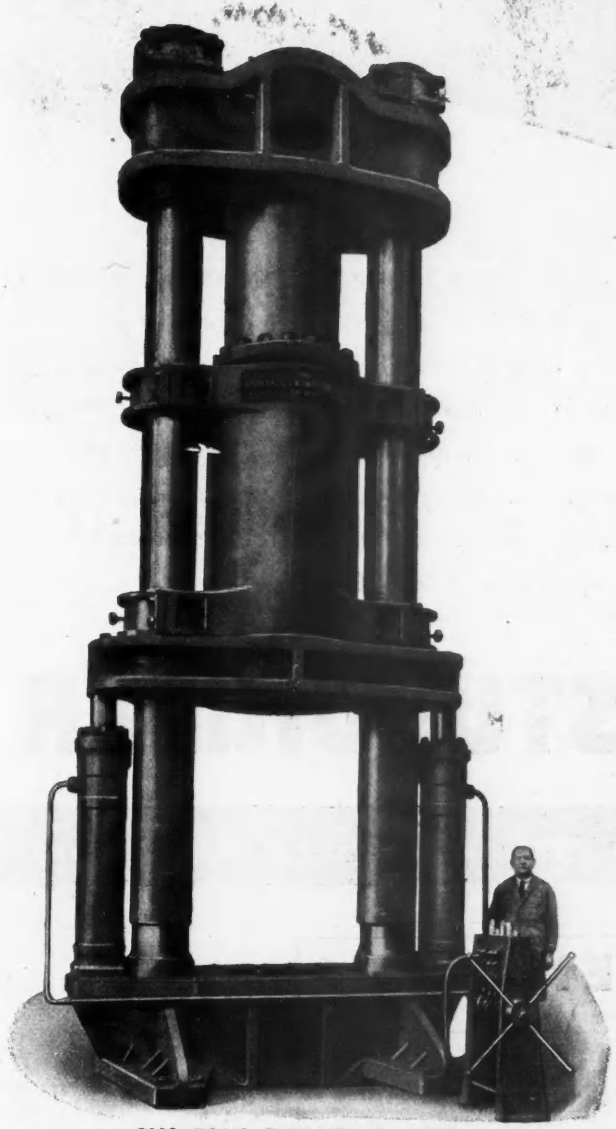

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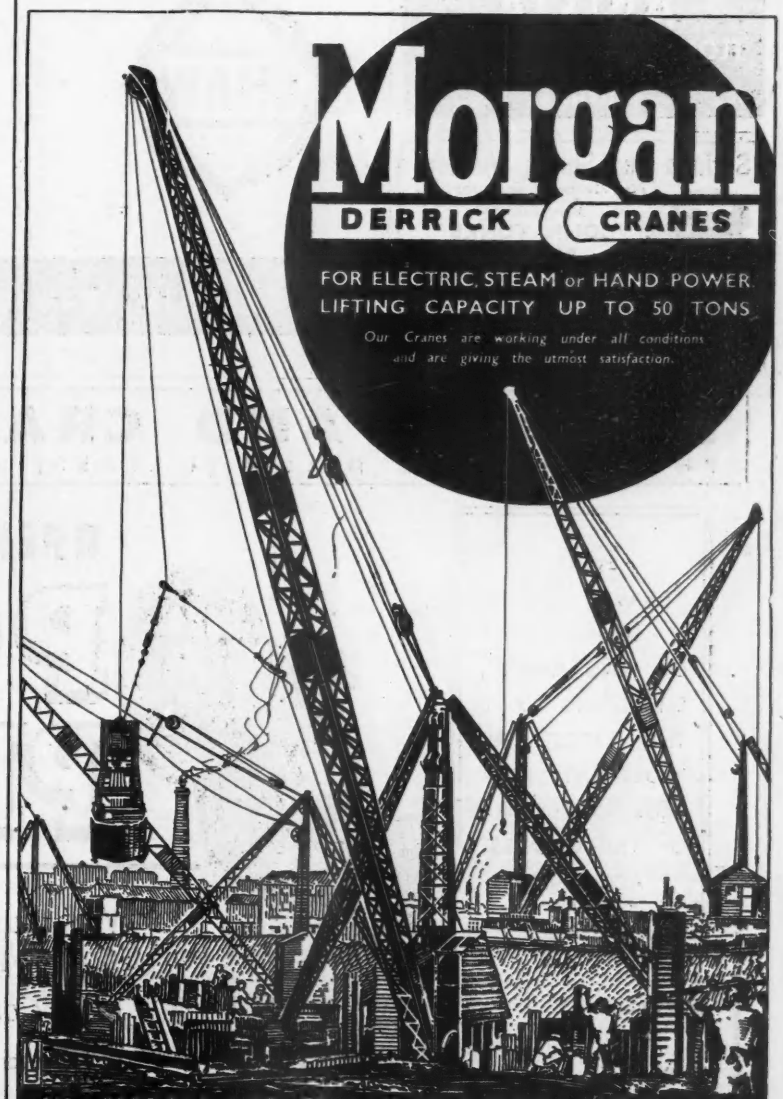

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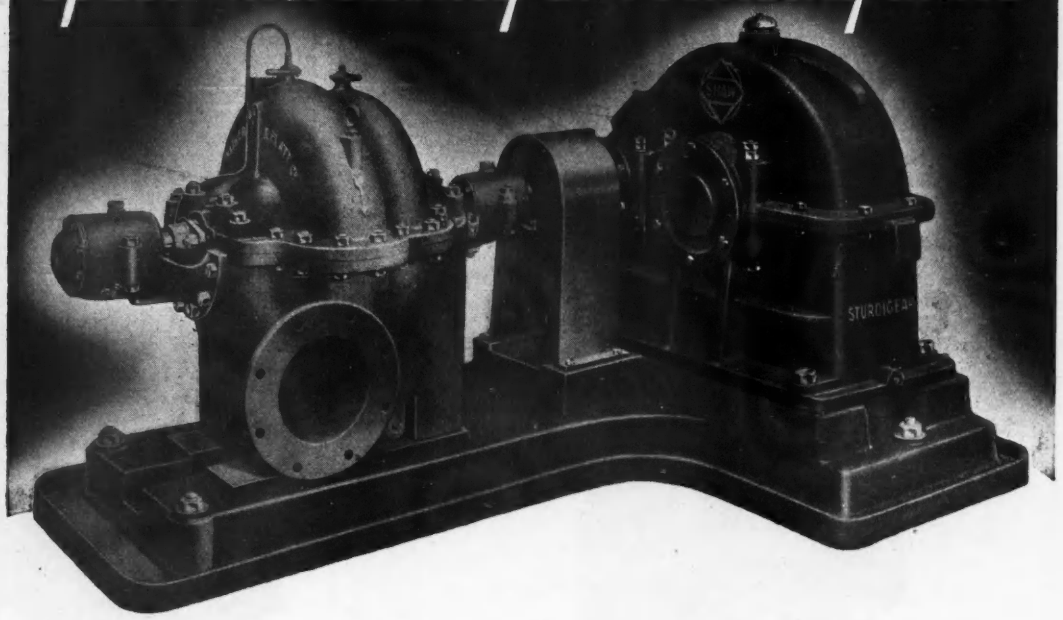

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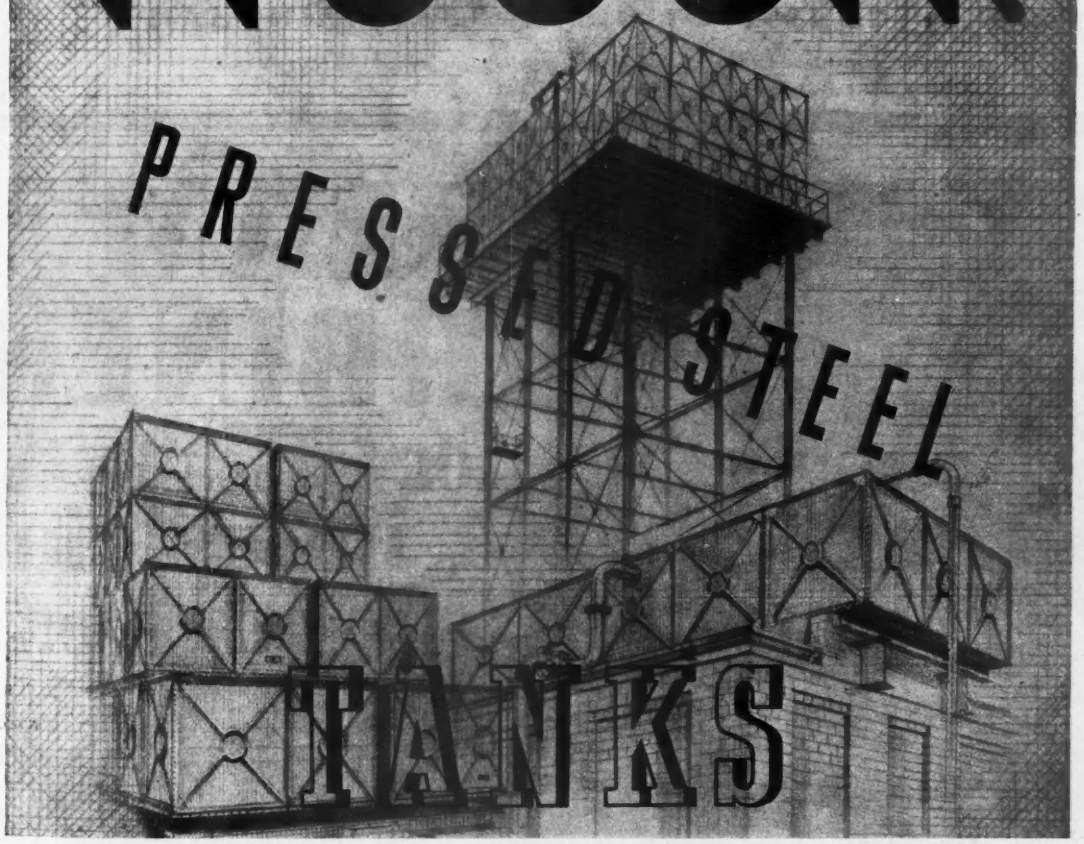

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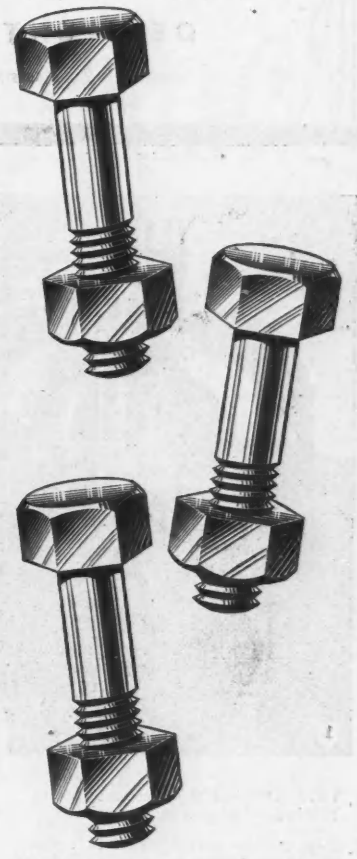

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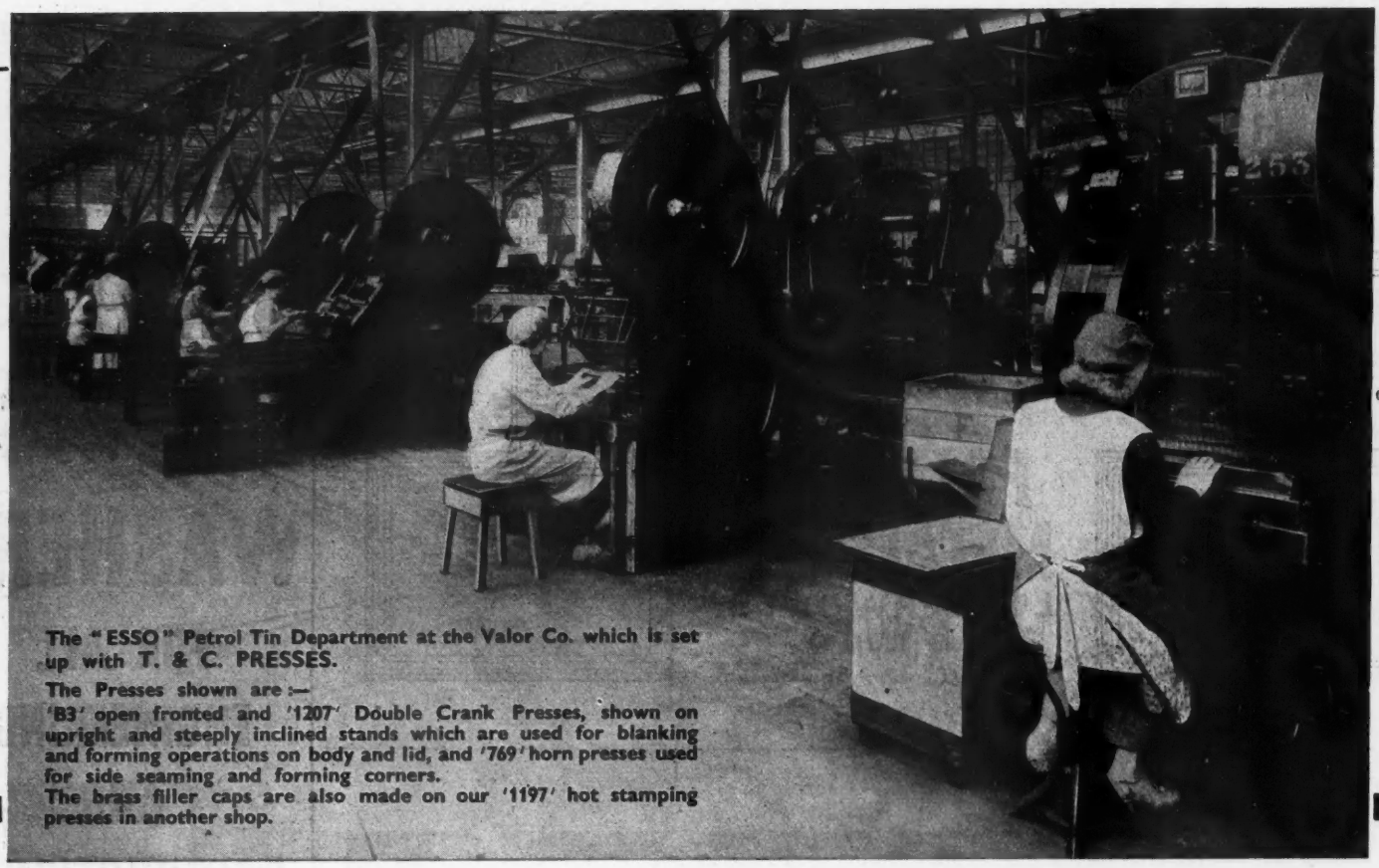

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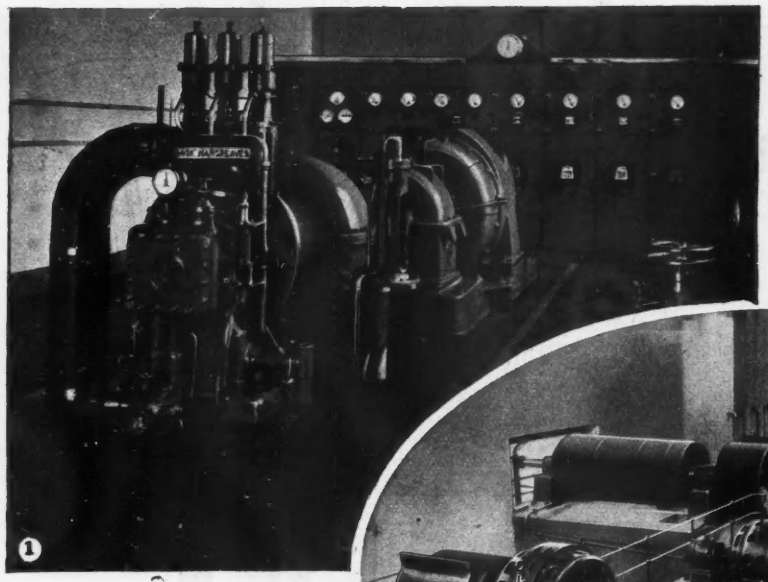

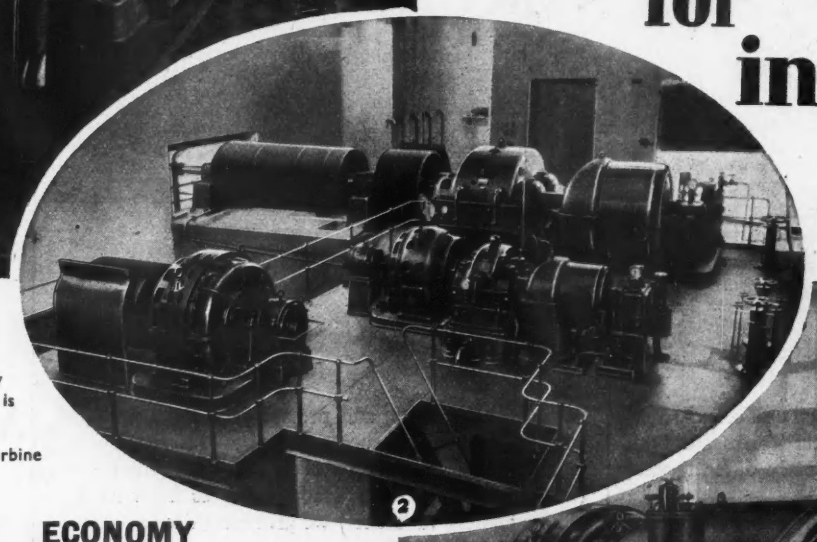

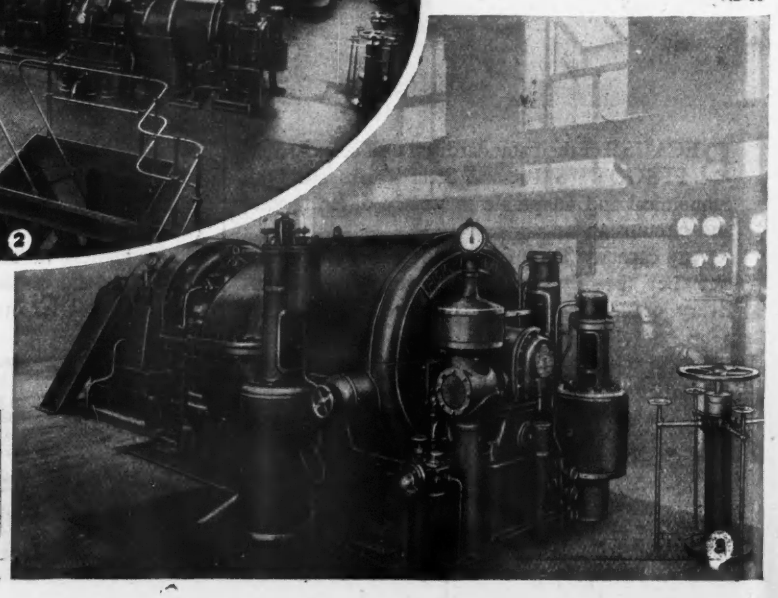

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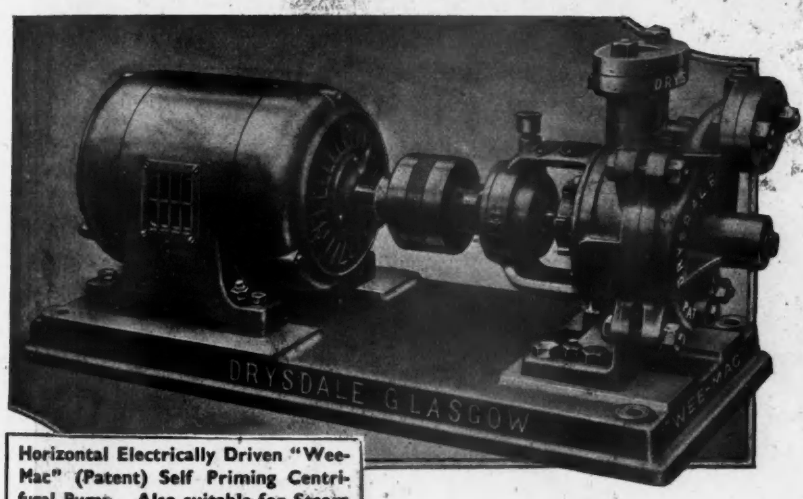

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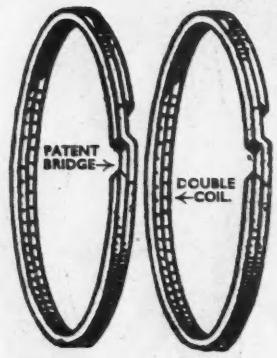

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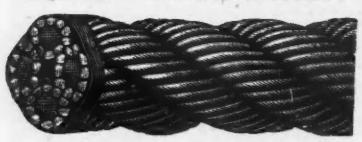

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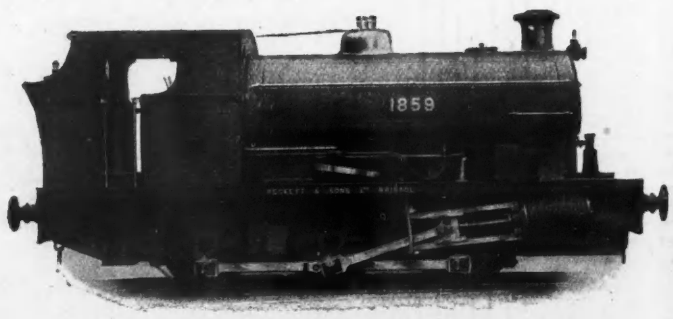

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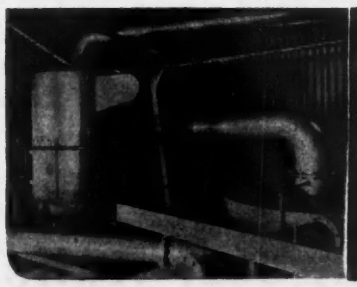

The illustration shows a "Sirocco" Pneumatic Conveyance Plant in a large industrial works.

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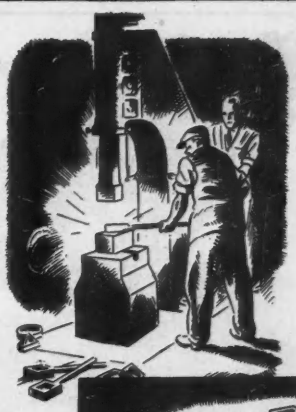

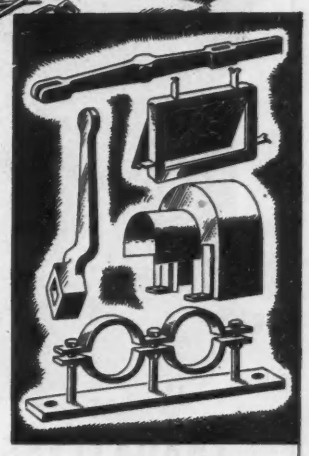

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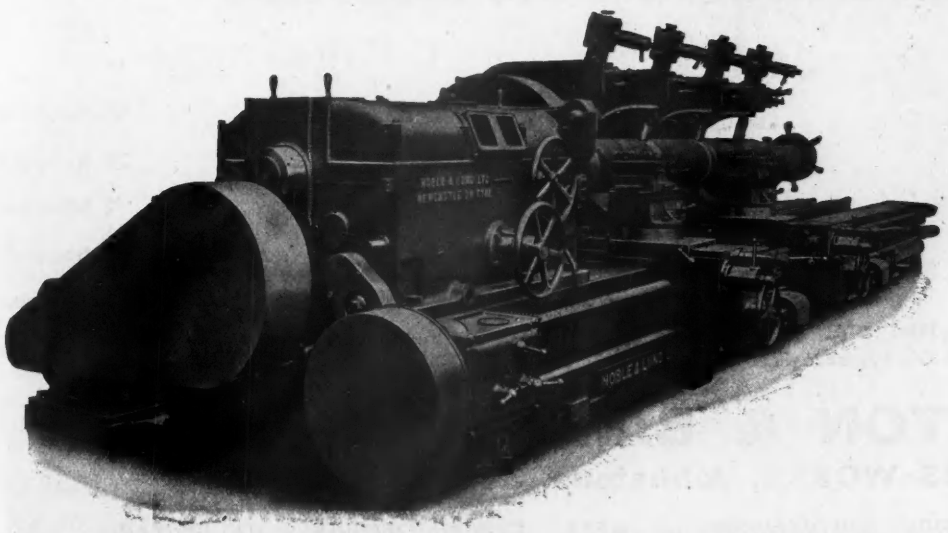

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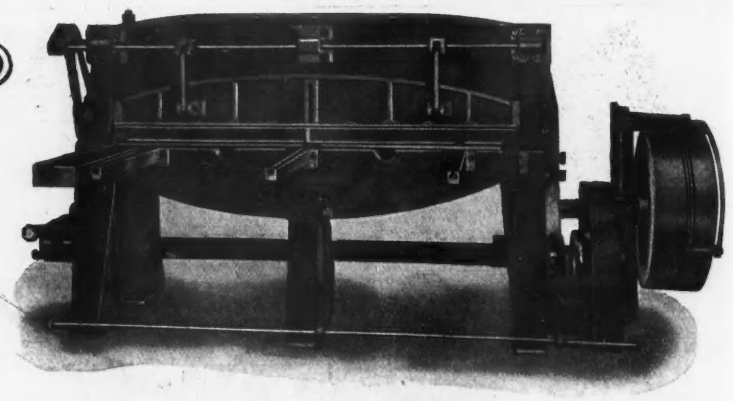

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This powerful machine, illustrated above, will cut Mild Steel Plates ½ inch thick, of unlimited width, and also will cut curves of small radius in any direction.

The above type is adapted for Belt Drive, the pulley driving through the friction clutch at a Speed of 240 r.p.m. At this speed the machine will cut at the rate of approximately 6 feet per minute.

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The Body is of cast steel of very substantial design.

All gearing is of steel, accurately cut from the solid.

The cutters are self-feeding, and of special quality of steel.

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COMPLETE WITH FRONT AND BACK GUIDES. CAM-OPERATED HOLD-DOWN ARRANGEMENT.

This machine is designed to deal with ½ inch mild steel plate, and is of ample strength and rigid construction to deal with this thickness of material, the full length and continually working.

A cutting speed of 20 to 25 cuts per minute is recommended.

Control of the machine is very simple, working by means of treadle, operating clutch.

The machine is put into motion by pressing down the treadle, which works sliding plunger. This allows key to engage in large gear wheel. As soon as the machine is in motion no further weight is needed and the treadle can be released. The machine then continues working until the sheet is cut, and the top beam reaches its highest point. The sliding plunger then automatically withdraws the key in shaft, and the machine stops at the top of its working stroke, thus leaving the machine so that the sheet to be cut can be set at will, or pushed to gauge, as in the case of repetition work. Clutch operating gear is fitted with a "trip" motion, which, when in operation, only allows the machine to make one stroke even if the treadle is still inadvertently depressed. This "trip" motion can be released and the machine can be used for continuous cutting if desired.

The shearing slide is well balanced and accommodated in box guides of ample dimensions, with adjustable gibs to take up wear. The shear blades are of good, high grade steel.

The squaring guides at each end of table are sunk into the table ensuring them being always square with the cutting edge without requiring any setting up.

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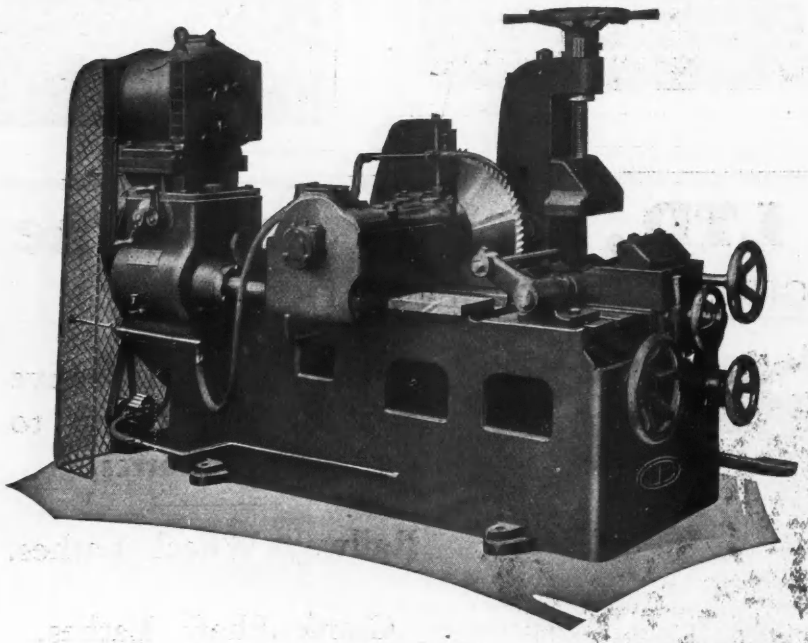
THE FRONT CUTTING MACHINE CUTS THE SHORTEST WAY



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Bars, Ingots, Rails, Joists, Channels, Angles, etc.

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3in. dia. M.S. Bar	30 Seconds
6in. dia. M.S. Bar	70 Seconds
95 lb. Rail	2 Minutes
12 x 6 Joist	45 Seconds
24 x 7½ Joist	2½ Minutes

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NORTH BRITISH LOCOMOTIVE Co., LTD., GLASGOW.

BUILDERS OF ALL TYPES OF

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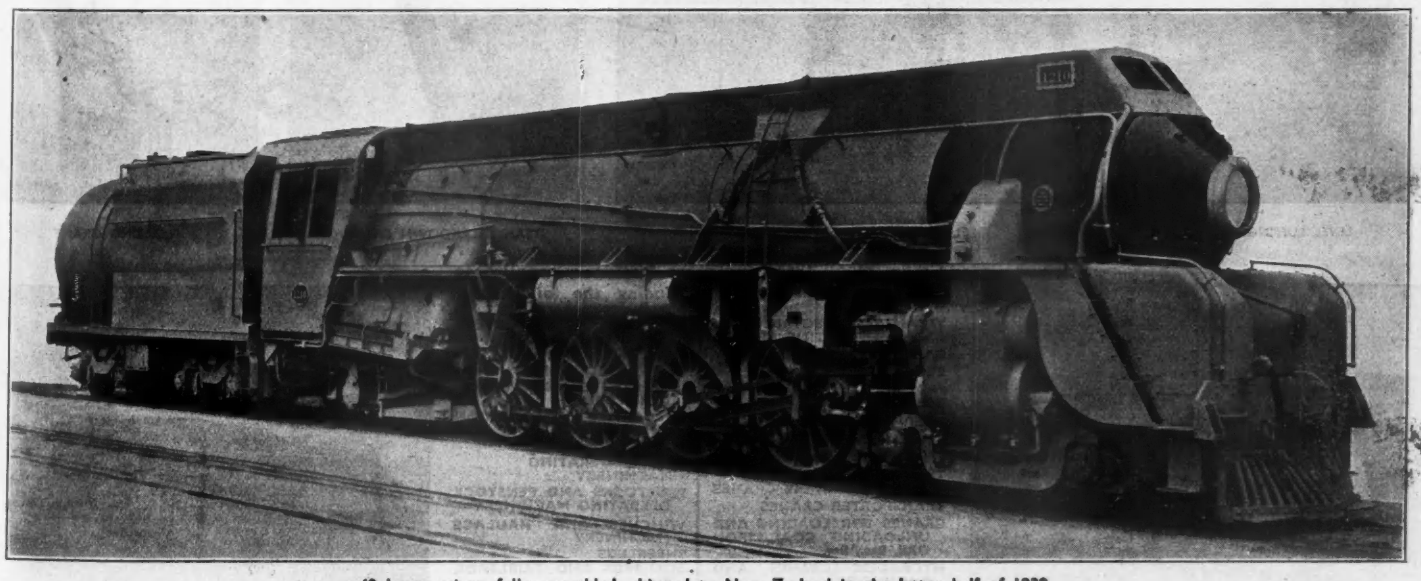

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Cylinders (2) 18" dia. x 26" stroke. Heating Surfaces 1469·0 sq. ft. Tank Capacity 4000 gallons.
Superheater „ 283·0 „
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In all branches of engineering FERODO friction linings prove their inherent quality by withstanding arduous duty over long periods. Frequent relining is not necessary with FERODO and lower operating costs are obtained. For dependability, lasting wear and resultant economy it pays to specify FERODO Friction Linings

Always specify FERODO FRICTION LININGS

The "David Brown" Tractor, hauling a double-disc harrow, is fitted with Ferodo Friction Linings.

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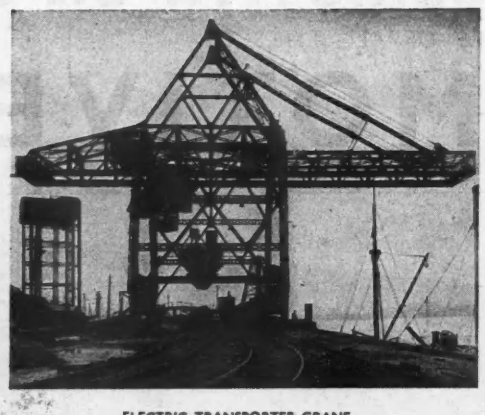

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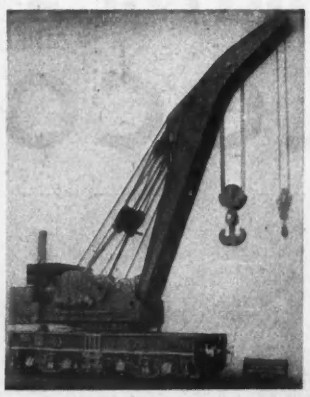
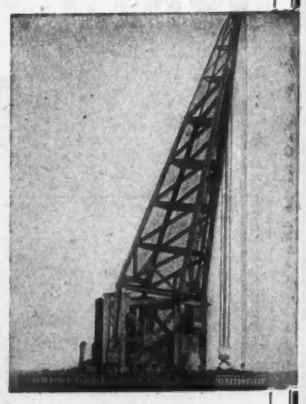


STEAM BREAKDOWN CRANE



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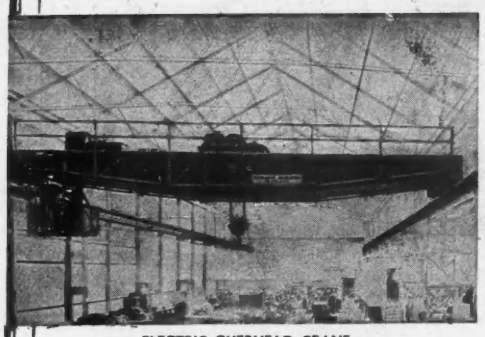

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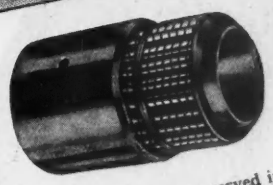

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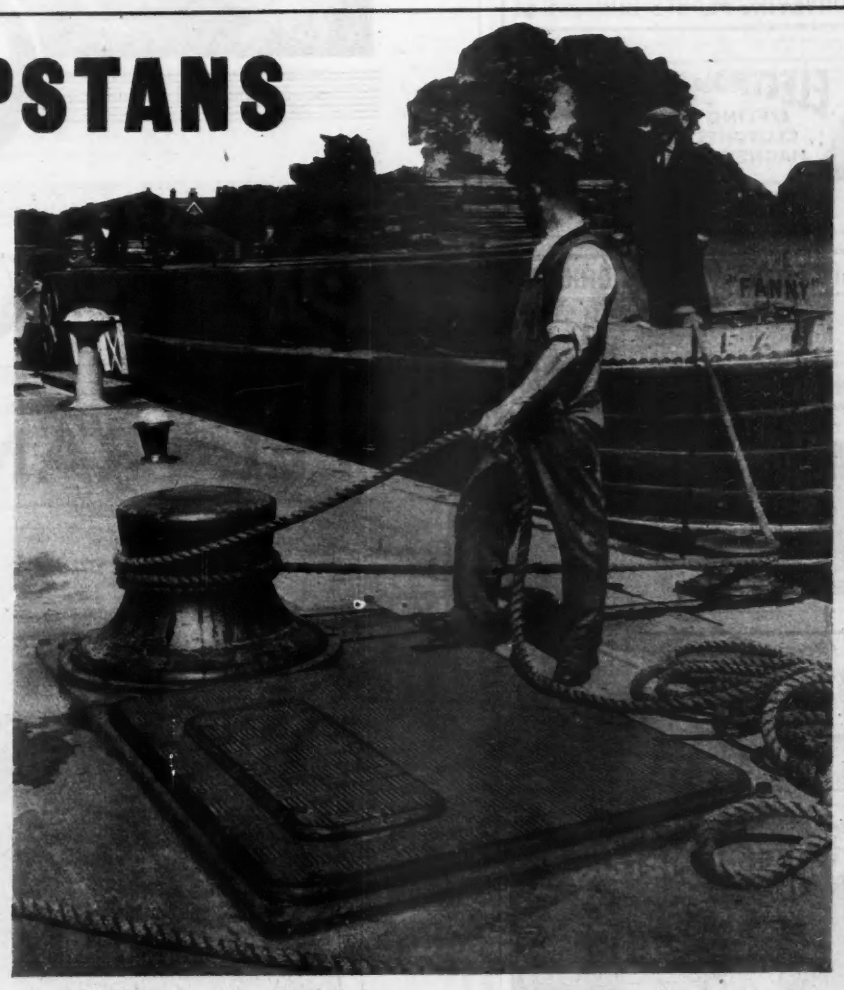

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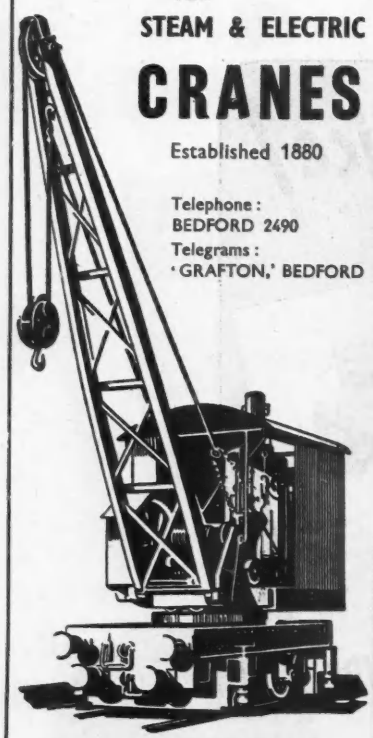

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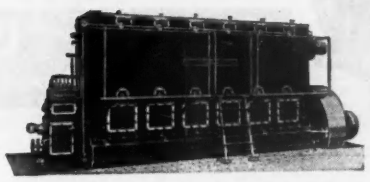

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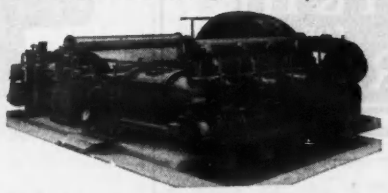

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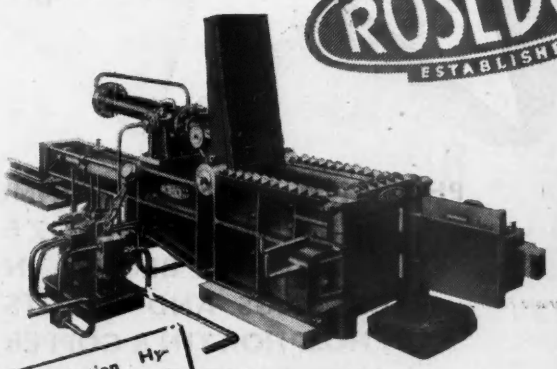

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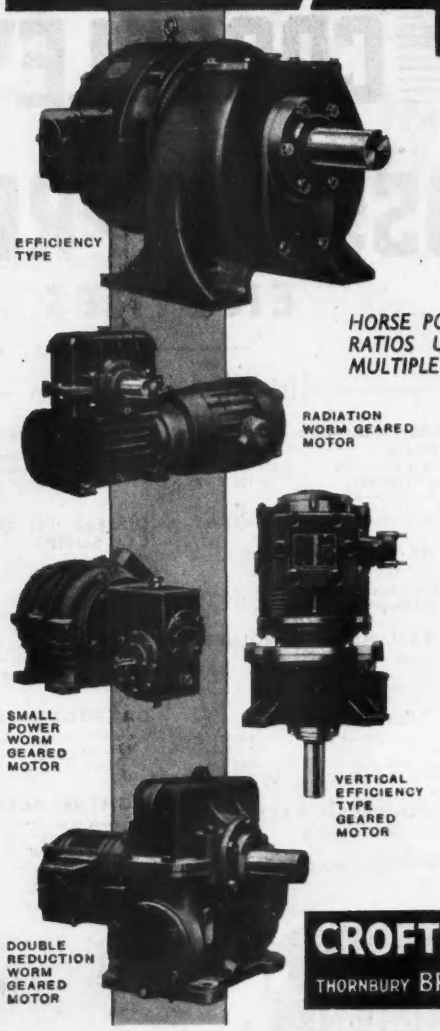
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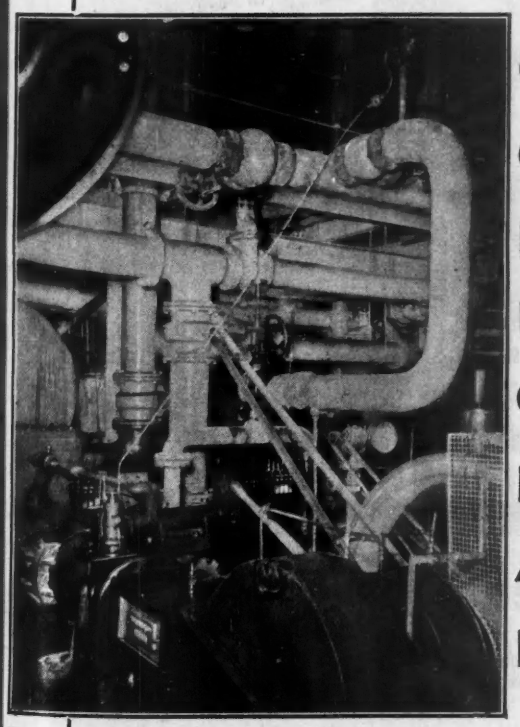

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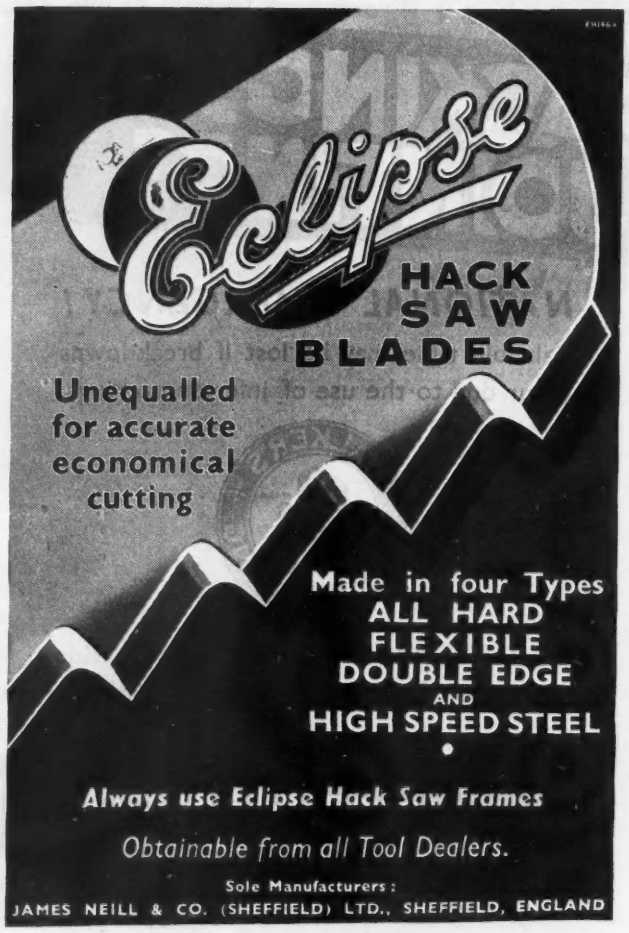

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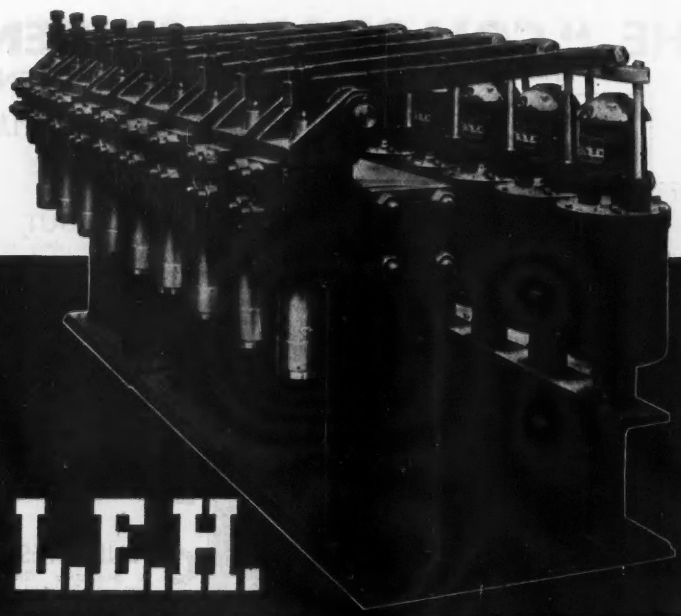

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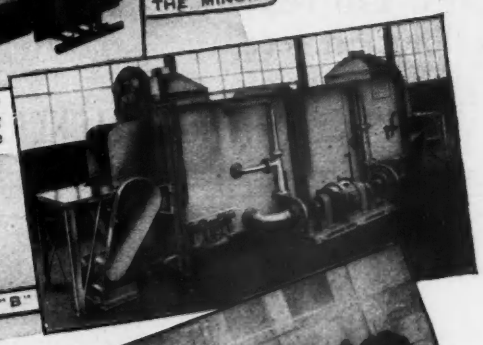

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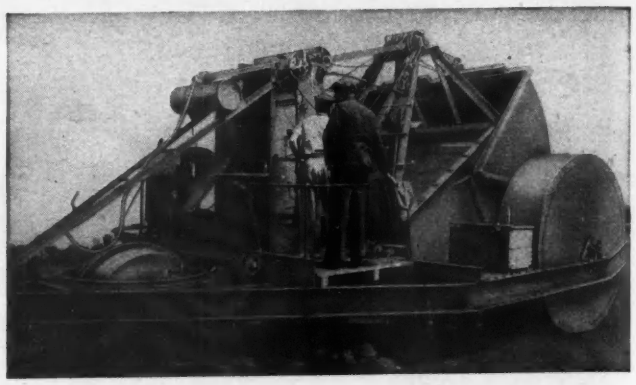

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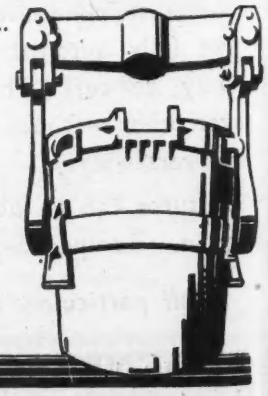

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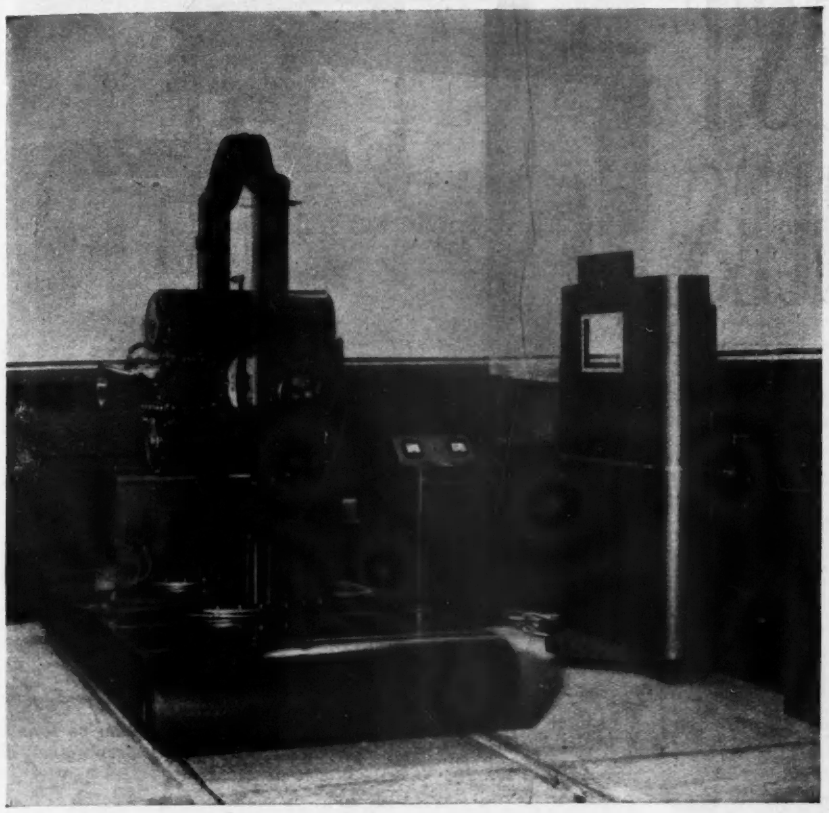

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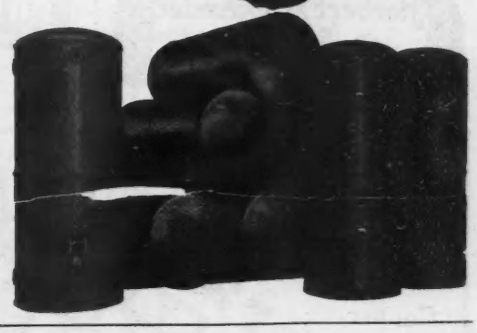

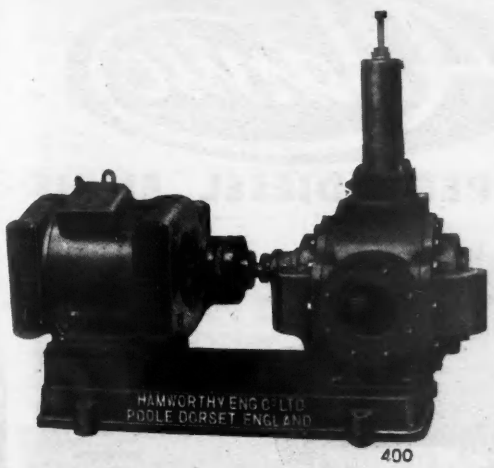

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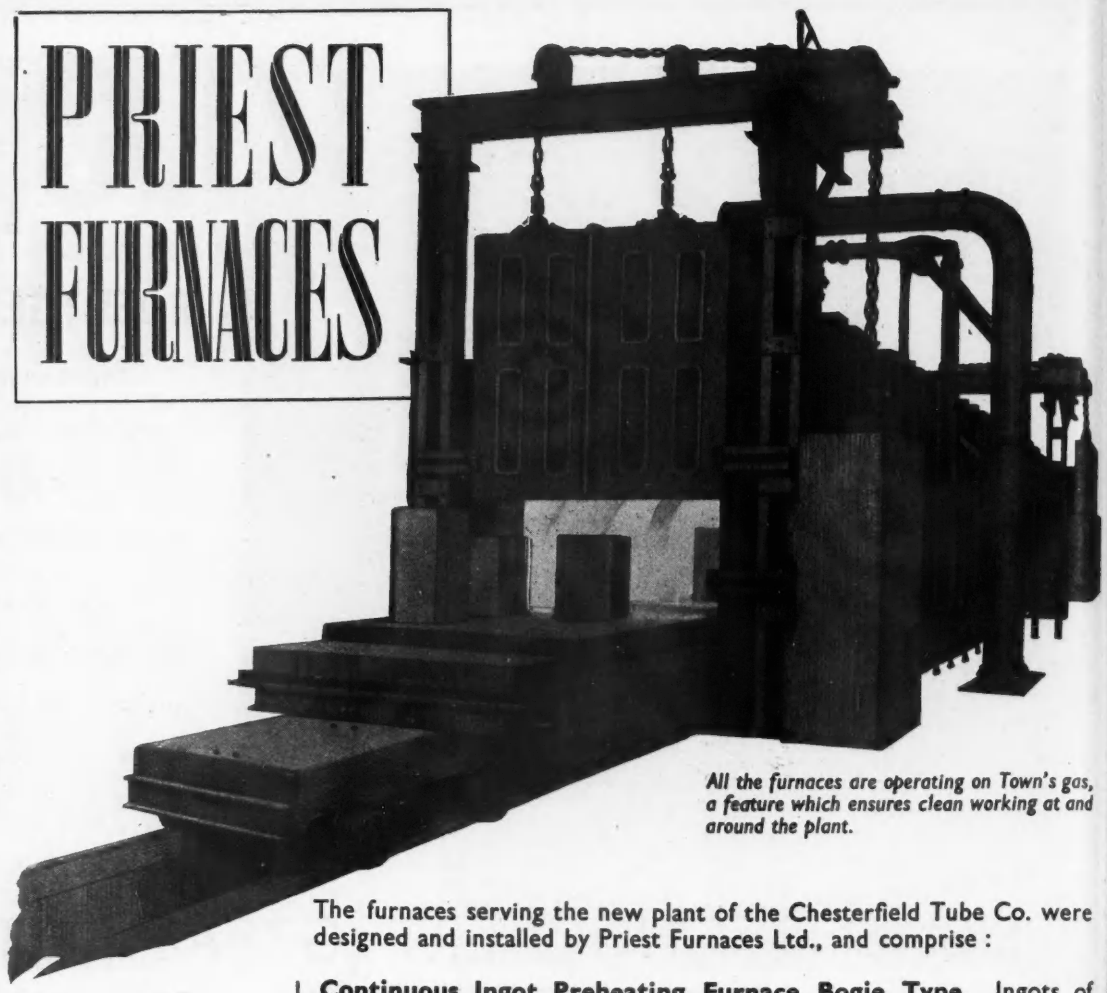

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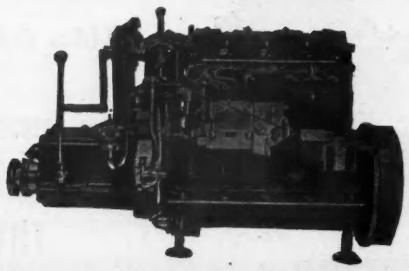

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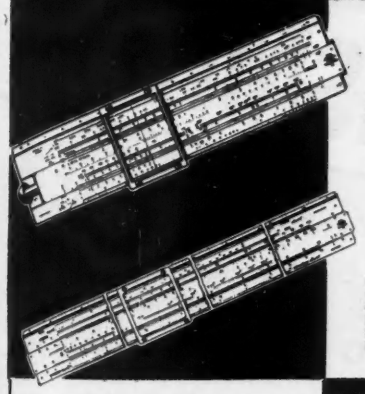

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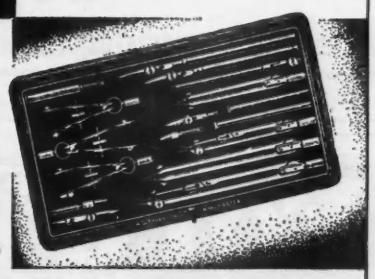

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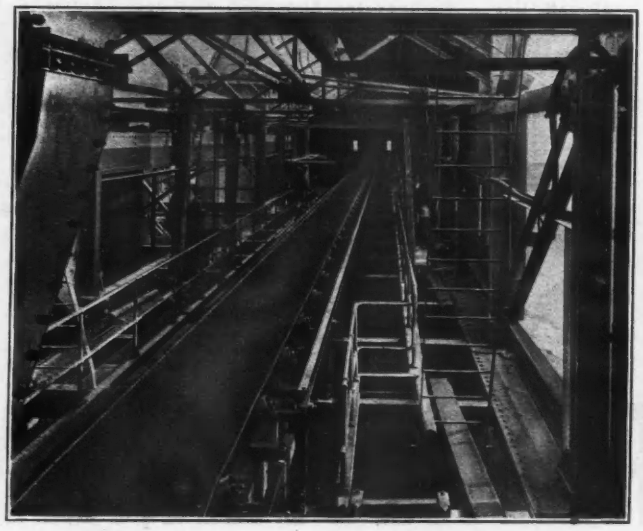

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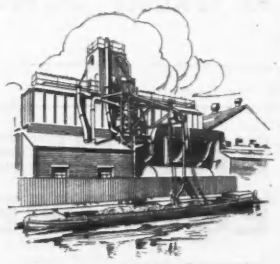

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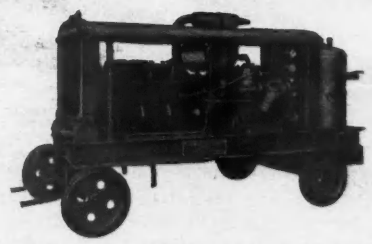

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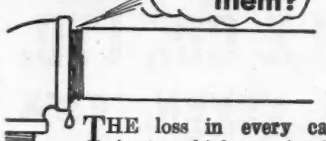

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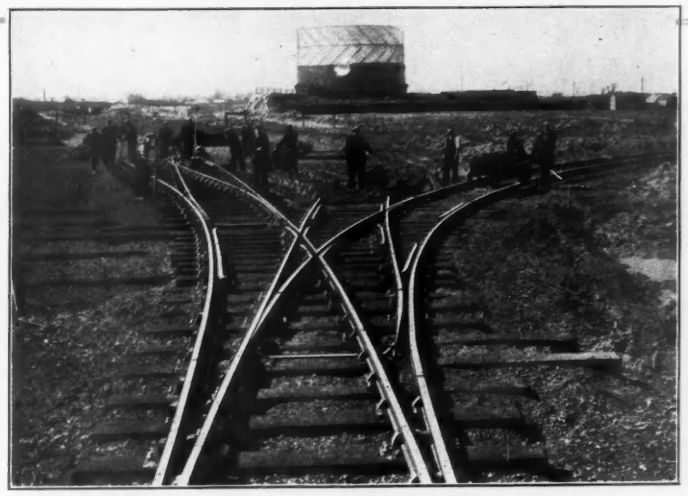

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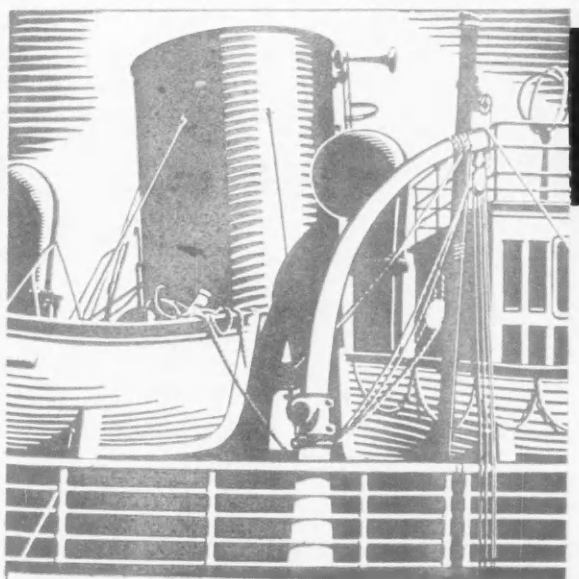

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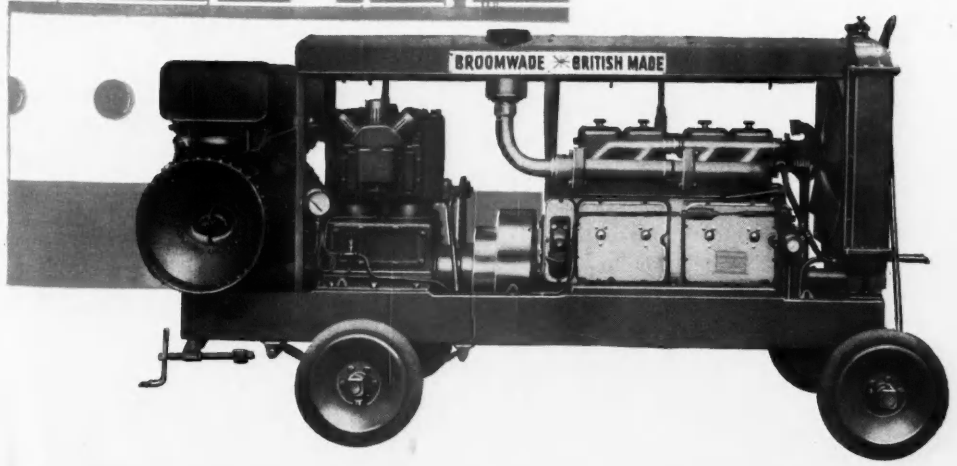

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